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CONTENTS

	Page
Social Security and Social Services	585
The Case for Pasteurization. By Prof. H. D. Kay, O.B.E.	587
Psychology and Religion. By Rev. J. C. Hardwick	588
Biochemistry—General and Particular. By Dr. E. F. Armstrong, F.R.S.	589
Sociology as an Academic Discipline. By Prof. George Catlin	590
Psychology of War and Peace	590
Rutherford : Life and Work to the Year 1919. By Prof. H. R. Robinson, F.R.S.	591
Recovery of Metals from Scrap. By Sir Harold Hartley, C.B.E., F.R.S.	594
Family Size and Survival in Great Britain. By Dr. Percy Stocks	597
Public Health in Great Britain. By Sir George Newman, G.B.E., K.C.B.	599
News and Views	600
Letters to the Editors :	
Effect of an Enzyme from Kidney on the Solubility of Calcium Phosphate.—Dr. H. Lehmann	603
New Heterocyclic Systems.—Dr. F. G. Mann, F. G. Holliman and D. R. Lyon	603
Superconductivity and Liquid Helium II.—Dr. J. G. Daunt and Dr. K. Mendelssohn	604
Tensile Strength of Water and Liquid Structure Theory.—Dr. R. S. Silver	605
Iron Electrode Potential in a Magnetic Field.—A. L. Parson	605
Chlorosis in Tomatoes.—B. T. Cromwell and J. G. Hunter	606
Determination of Moisture Content.—Dr. L. G. G. Warne	607
The Saqqara Graph.—R. S. Williamson	607
Role of Protozoa in the Activated Sludge Process.—Dr. S. H. Jenkins	607
Research Items	608
Insect Fauna of a Brine-Pit. By Frederick Burke	610
War-time Transport in Great Britain	611

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SOCIAL SECURITY AND SOCIAL SERVICES

THE interdepartmental Committee on Social Insurance and Allied Services under Sir William Beveridge's chairmanship, set up to survey the existing schemes of social insurance and allied services, including workmen's compensation, and to make recommendations, the report of which is expected shortly, is dealing with a problem that closely concerns one of the great purposes of the nations now fighting for freedom and for a civilization based on respect for human personality. The idea of social security springs from the deep desire of men to free themselves from the fear of want. To realize this idea the causes of insecurity must be removed wherever possible, and the individual assured of that protection against the common risks of life which he cannot provide by his own unaided efforts.

The fact that the dangers and uncertainties of war stimulate many of the highest virtues of individual men and women should not lead us to underrate the great significance of freedom from want. When insecurity lasts for years and becomes part of a nation's life, its effects are just as deadening as those of unbroken security. For the last twenty-five years more than half the population of Great Britain has lived on the knife-edge between poverty and destitution, and the fear of falling into one or the other has stultified initiative and led to a desperate saving for the future at the expense of the present. Various stop-gap social services relieved, but did not cure, poverty and unemployment. We are at last coming to realize that the survival of democracy after the War depends on the replacement of unemployment by full employment and the reconciliation of security with freedom.

It is a significant sign of the times that recognition that the achievement of social security depends both on social and economic planning and on the willing acceptance by a free community of the sacrifices and restrictions involved is becoming more widespread. It is elaborated in a notable broadsheet, "Planning for Social Security", issued earlier in the year by Political and Economic Planning (P E P), which is based on a memorandum submitted to the Beveridge Committee. It is also implicit in one of the latest Studies and Reports of the International Labour Office, "Approaches to Social Security : An International Survey". This latter report does not merely round off the long series of studies of the International Labour Office on social insurance and assistance by reviewing the contributions to social security of these modes of bearing social risks. It is also intended to prepare the way for planning a complete social security programme in readiness for post-war reconstruction.

The resolution on aims and functions of social insurance, adopted at Havana in December 1939 by the Second Labour Conference of the American States which are members of the International Labour Organisation, shows the extent to which the social security ideal had taken shape in the minds of

American Governments before President Roosevelt's famous Four Freedoms speech or the Atlantic Charter. The resolution is appended to "Approaches to Social Security", the whole forming an admirable survey of the essentials by which the proposals of the Beveridge Committee will in due course be judged. The essay is a statement complementary to the P E P broadsheet, which is limited to a discussion of British practice and to British proposals, the merits of which are the more clearly seen against this background of general tendencies and experience.

A brief survey of social insurance shows clearly that responsibility for meeting social needs has been dispersed among numerous agencies, without much regard for plan or order, and the illustrations given in the third chapter of "Approaches to Social Security", on co-ordination of social assistance and insurance into a coherent system of social security, indicate the measure of what remains to be done to establish a system affording reasonable security for all who need it. Moreover, it must be recognized that security is a state of mind as well as an objective fact. To enjoy security there must be confidence that the benefits will be available when required, and to afford security, the protection must be adequate in quality and quantity.

Elimination of the causes of social insecurity consolidates and improves the structure of society, but social security policy can only be planned as part of a larger programme which includes measures for promoting employment and maintaining it at a high level, for improving nutrition and housing, multiplying facilities for medical care and widening opportunities for general and vocational education. Social security services are promoted by economic adjustments that make for the expansion of employment and for the distribution of income so as to procure the essentials of decent living, with due consideration for family charges. Such adjustments facilitate the financing of social security schemes, not only tending to keep benefit expenditure within bounds, but also to reduce it, since improved conditions of life and labour reduce the frequency and severity of social and industrial risks.

Compared with this survey, the P E P broadsheet is much more forthright and critical. Its major interest lies, however, in the constructive proposals advanced in regard to principles of reconstruction and a Ministry of Social Security. It puts forward a provisional scheme for a process of reconstruction which might extend over the next thirty years. It is an examination of basic principles and an attempt to define the objectives of long-term reconstruction, but it does not discuss secondary or immediate issues.

Besides the establishment of a national Plimsoll line of goods and services, the State must assume the wider duty of planning the use of our economic resources and man-power for full employment and maximum welfare. The building of post-war social security, moreover, will depend on acceptance by the citizen of stronger obligations and new compulsions. The opportunities and responsibilities which enhance the freedom of every citizen by making his rights real can only be enjoyed when the price is paid of accepting expert advice and skilled services to find work, to be trained or transferred for work, and to keep fit or to be speedily restored to health and independence. If we can get away from the futility of pressing a man to train for a job which does not exist; or of putting a sick man on to an inadequate allowance and driving him back prematurely into industrial conditions which can only undermine his health again, and remove some of the administrative absurdities and complexities, we shall have little cause to fear that the development of a social security system will sap the morale and independence even of the nation's least responsible elements.

The first essential, according to *Planning*, is therefore the establishment of a Ministry of Social Security to take over, among other things, administration of all income-maintenance services.

In regard to detailed services, the broadsheet suggests the unification of the medical services by divorcing them financially and administratively from National Health Insurance and from public assistance, and organizing them in one national system which provides its services to all citizens as a right. To extend the scope of the National Health Insurance scheme to include persons of "like economic status" and the dependants of all insured persons, and to afford a far wider range of skilled services, as suggested by the National Conference of Friendly Societies, are regarded as likely to impede rather than promote the unification of health and medical services into a comprehensive national system. It is a cumbersome approximate to the ultimate solution visualized by the Royal Commission of 1926 of "a carefully built up service organized on a single local basis in which all varieties of preventive and curative work find their appropriate place".

The advantages of a system in which all medical services are provided on the basis of common citizenship to every member of the community are detailed, and the idea of the health centre and of co-operation and team-work among doctors and closer contact with specialists, with the benefit to the general level of medical work, are well set forth in the broadsheet. Similar points were stressed by the Dawson report of 1920 and developed in the recent report of the Medical Planning Commission of the British Medical Association, as well as in the report on National Health Services written by Dr. Janet Campbell for the British Association for Labour Legislation. While the local health centre may provide new opportunities for active citizenship on a neighbourhood basis, a reconstructed income-maintenance system can clearly hold no place for administration of incapacity cash benefits by approved societies. That system must disappear, since the only approved society required is the nation itself.

Naturally enough, the broadsheet does not go into the detail of the recent report of the British Medical Association's Committee on Industrial Health in Factories, but it recognizes the contribution which such a Board through its industrial medical service might make towards extending first-aid services and raising their quality—a field in which air-raid pre-

cautions should not be without effect—as well as in passing on research problems to the Industrial Health Research Board. Any step which tends to stimulate industrial health research indeed merits careful examination, and among the further suggestions of *Planning* are, first, the development of an adequate system of first-class centres and departments for traumatic surgery, and, secondly, the creation of a proper system of special centres for diagnosis and treatment of occupational diseases and for research into their causes and conditioning factors. Here the British Medical Association's Committee on Industrial Health in Factories has rightly stressed the importance of co-operation between the medical profession, scientific workers, the factory inspectorate, employers, social workers, and the workers and their organizations. Finally, the Board should be responsible for vocational training schemes as well as entrusted with the care of all physically handicapped persons who might be rendered fit to engage in a remunerative occupation, and it should maintain a specialized service for placing disabled workers. The whole network of services involved in medical rehabilitation is so intimately bound up with other medical services, including hospitals, that they should be provided and controlled by the same authorities which are responsible for all the major medical services, although the Board should have powers of supervision and inspection of facilities.

This valuable broadsheet makes it unmistakably plain that any real unification and reconstruction of the social services in Great Britain will involve an immense amount of educational work to ensure the full co-operation, not merely of the numerous societies and local authorities concerned, but also of the individual citizens. It is the more welcome, therefore, that such a document should have appeared in advance of the Beveridge report, and that attention should also be directed to a scarcely less ambitious project in the Americas. The conference which met at Santiago de Chile affords evidence that in America also resources are being pooled in a positive effort to realize the common ideals of freedom from want and fear. A committee has already been constituted for the systematic and continuous exchange of information among the social security institutions of the American countries, and has set as its goal the establishment in each country of compulsory social insurance, covering industrial accidents and occupational disease, sickness, maternity, old age, invalidism, premature death, and involuntary unemployment, and applying to self-employed peasants and domestic servants as well as to industrial and commercial workers.

The case for a comprehensive and well-planned system in Great Britain could scarcely be better put than in the P E P broadsheet, and that such widespread attention should be given to this question of social security is a hopeful sign. It should not be forgotten that domestic policies, by promoting full employment and purchasing power, have a most favourable reaction on those difficult problems which will be encountered in the reconstruction of world trade after the War. Already the U.S. National Resources Development Board, in its report for 1942 now before Congress, demonstrates that planning for social security finds an accepted place in the post-war plans of the United States. While it is reasonable that the Government should decide to await the Beveridge report before taking any action in regard to social services, there will be grave disappointment if there is delay in implementing a real social security policy and programme based on the recommendations of that report. Failure to do so would be a blow both to the immediate war effort and at the post-war aims and association of the United Nations.

THE CASE FOR PASTEURIZATION

The Pasteurization of Milk

By Prof. G. S. Wilson. Pp. xii+212. (London: Edward Arnold and Co., 1942.) 18*s*. net.

THIS is a well-planned, well-written and well-documented book, but with a title that may, to some, give a slightly wrong impression of its contents. It concerns itself almost entirely with one main theme—a reasoned statement of the medical evidence in favour of the pasteurization, or effective heat treatment, of all milk. The bacteriological, particularly the public health aspects of pasteurization, as might be expected from Prof. Wilson, are treated with care and thoroughness, and a balanced summary is given of the relevant nutritional findings of the past ten or fifteen years. It is, however, no manual for the pasteurization engineer or technologist—that book has still to be written—and the economic, legislative and administrative aspects of milk processing also are only very briefly touched on.

How it came to be written is explained by Sir Wilson Jameson in a foreword. The Milk Industry Bill, one of the few really constructive legislative efforts of the decade before the War, was introduced in November 1938 and, by what many consider a grave error of judgment, was withdrawn after its first reading. Among a number of other measures the Bill gave local authorities permissive powers, subject to certain limitations, to make pasteurization compulsory in their areas. After its withdrawal, representations were made to the Ministers of Health and Agriculture in the hope that further legislative endeavours would be made to rescue the safety of the milk supply of Great Britain from the wreckage of the Bill. Though these representations were unsuccessful, they convinced the then Minister of Health, Mr. Walter Elliott, that there was need for the further education of opinion on the whole subject of pasteurization of milk in relation to public health. He asked Prof. Wilson to bring existing evidence together and review it, and this book, publication of which was considerably delayed by the outbreak of war, is the result.

As propaganda—and that in no sinister sense—it is successful and convincing. People who wish to retain anti-pasteurization beliefs as part of their religion are strongly advised not to read it. If they do they can scarcely avoid being persuaded of two things: first the need, from the point of view of national health, for efficient heat treatment of all commercial milk before it is consumed by human beings, and second,

that pasteurization carried out by modern methods does not "rob milk of its essential elements" but has in truth a negligible effect on the milk's nutritive value.

One cannot help wondering, nevertheless, whether the book is not, now, knocking at a door already ajar. Even before the War the tumult and the shouting over pasteurization were dying, and the War itself has enabled a proper perspective to be achieved the more readily. The basis for the high emotional potential at which the pasteurization controversy, at its climax some fifteen years ago, was conducted was partly scientific, but to a much greater extent economic. The scientific world had, not very long before, been awakened to the essential part played by vitamins, particularly in the nutrition of the young, and to the fact that some of these factors were thermo-labile. Cow's milk was evidently one of their most important sources. Was not pasteurization, therefore, likely to diminish seriously the nutritive value of this vital food ? Was the alleged risk of disease and death—surely not a very serious one since very many drank raw milk but few seemed to suffer as a consequence—to be compared with the apparent certainty of loss of invaluable food factors as a result of heat treatment ?

Prof. Wilson collates and appraises existing data, and shows how serious is the first risk. His sombre statements as regards the extent of milk-borne disease cannot be far from the truth. As regards nutritive value, it has been clearly shown during the last seven or eight years that the effect of pasteurization on the vitamin content of milk, and on its nutritive value generally, is negligible. Prof. Wilson marshalls his evidence here very cogently, but quotes the several careful experiments begun about 1935 at the instance of the Milk Nutrition Committee (under the chairmanship of Lord Astor) on the feeding of comparable quantities of raw and pasteurized milk to children, to calves and to rats, as if they were just a number of sporadic and isolated investigations, whereas they were a planned and co-ordinated series which was designed to solve and, in fact, did solve, the question as to whether the commercial pasteurization of milk had any serious effect on the nutritive value of that milk.

A serious fear of those who opposed pasteurization so strenuously in the twenties and early thirties was that compulsory pasteurization—and none of us in peace-time likes anything compulsory—would increase the stranglehold of the large distributors on the producers of milk and would drive the producer-retailers out of business. There might have been some reason for this fear in the days before the advent of the Milk Marketing Board. Since that advent in 1935, the organized distributors have had to deal with an organization no less formidable than their own, and the economic argument against pasteurization has become far less intense. Nevertheless it is unlikely to disappear while producer-retailers exist who cannot pasteurize their milk before distribution. In such cases, is there to be a place for tuberculin-tested raw milk ? This question is at present of increasing quantitative importance, as the gallonage of milk retailed by producer-retailers has greatly increased since 1939.

The producer-retailer's case may be met after the War by the increased manufacture of small 'batch' pasteurizers that were being developed in the thirties to deal efficiently with fifty gallons of milk or even less. With the perfection of these plants—associated with a policy of partnership among the smaller producer-retailers to establish units of a reasonable economic size—the objective of the pasteurization of *all* milk for liquid consumption in Great Britain will be within technical range. Prof. Wilson says, "the need for pasteurization is fully justified by all the available scientific evidence and is supported by such a wealth of authoritative medical opinion as has seldom before been united in favour of any measure. . . ." He might without distortion have added "dairy scientific opinion", which has to consider, in addition to the medical aspects, other bearings of the pasteurization question.

H. D. KAY.

PSYCHOLOGY AND RELIGION

Psychology and Religious Truth

By Dr. Thomas Hywel Hughes. Pp. 160. (London: George Allen and Unwin, Ltd., 1942.) 7*s*. 6*d*. net.

IN these lectures Dr. Hughes deals with some of the estimates of religion formed by psychologists. Freud's view that religion originates in the sex instinct is rejected by Dr. Hughes on the ground that this instinct is not itself fundamental but derivative from the will to live, which he regards as being the source of religion. He includes under this instinct not only the impulse to keep alive but also the wish to live well, for he takes the view that a spiritual no less than a biological need expresses itself in the will to live. Especially is this the case when a self-conscious stage has been reached. Also, religion arises from and gives expression to the whole personality and not just to a part, for example, the sexual. The view associated with the names of Durkheim and Levy Bruhl, that religion originated in the herd instinct, is also rejected. According to Levy Bruhl, the conception of God is in reality nothing but the idea of society or social cohesion, as it finds its unity in strong emotion. The decisive objection to this theory, in Dr. Hughes's opinion, is the fact that religion is an intensely individual and personal matter, and however far back we go, we find that religion begins in single souls who initiate the social movements in religion.

Some psychologists, of whom Leuba and Freud are examples, have taken the view that the idea of God is an illusion due to two familiar mental processes, projection and regression. The human mind projects and personalizes its own private feelings and desires, and often gives its projections content and meaning by clothing them in a garb of early memories and experiences. But Dr. Hughes points out that this process of mental projection is not necessarily a form of self-deception. Some of the principles upon which all our scientific knowledge is based are such projections; for example, the principle of the unity and uniformity of Nature. Nature itself as it appears to the observer is far from being a unity, but the scientific inquirer projects into Nature his own consciousness of personal unity. Just as he is himself the integrating bond which links into one whole all his diverse experiences, so he projects upon the diversity of Nature a similar principle of unity. It by no means follows that such a procedure is illegitimate; on the contrary, it has proved highly fruitful in results, and has enabled Nature to be reduced to order and understood. A similar projection is the idea of causation, which projects on to Nature man's consciousness of initiating action. From the mere observation of Nature only a succession of events is discernible, as Hume pointed out; the idea

of causation is a projection of the human mind, which is justified by results.

Dr. Hughes also examines Leuba's estimate of religious experience as of like nature with the experiences resulting from drugs, alcohol, or some pathological state. That some mystical states are subjective and induced by drugs or other similar means does not warrant the conclusion that all mystical states are illusory. One might argue that the illusory nature of the snakes observed with so much distinctness by the sufferer from delirium tremens proves that all snakes are illusory. Moreover, the effects of genuine religious experience are very different from those induced by opium or gin; they strengthen and enrich the character, bestowing upon the individual the capacity to endure the heaviest strains, mental, moral and physical. The prophetic utterance, "And a little one shall become a thousand", has come true often enough in the history of religion, which can release hidden potentialities to a surprising extent.

In opposition to the Behaviourists, Dr. Hughes is confident that "a psychology with a soul" is now in the ascendant, "perhaps more so than at any time since the beginning of modern philosophy in Descartes". He holds that this is largely due to the psycho-analytic school, who have put the *psyche* with its moods and energies at the centre of their teaching. One of the great gains to psychology from the new psychology, in his view, has been that it has rid the study of the predominantly material and physiological bias so long associated with it. He observes that the problem of the relationship between body and mind is by no means settled; he does not refer to Sir Charles Sherrington's recent pronouncement as to the impossibility of reducing mind to terms of energy. But he expresses the opinion that "the trend of psychological thought is towards regarding the idea of a future life as at least probable".

Dr. Hughes also has interesting chapters on the bearings of psychology upon certain specific Christian doctrines, such as the Trinity, the Atonement, and the Person of Christ. The discussion of the doctrine of the Atonement will perhaps be of most interest to psychologists, as facts of human nature are primarily concerned. Dr. Hughes observes that Freud "has revived the conception of original sin, and even afforded some support to the idea of total depravity". Another point is the distinction drawn by modern psychology between sin and moral disease, which has made it easier to deal with certain weaknesses of character. On the other hand, it is important to realize that sin is always a matter of the will and implies personal responsibility. The notion of moral disease may easily be led to 'cover a multitude of sins' to the doubtful advantage of the patient. We could wish that while dealing with this topic Dr. Hughes could have devoted some space to an examination and evaluation of the Pauline psychology of 'spirit' and 'flesh' which is certainly out of date, and which gravely affects the efficiency of the attempts of the Christian church to give guidance on certain moral problems. One feels that if one is to equate the 'flesh' with the 'libido', it must be the source of much that is of value as well as of some things less attractive. But perhaps Dr. Hughes will deal with this and other similarly interesting questions, among which we should include the body-mind problem, in another series of lectures. Meanwhile he deserves our thanks for a very useful piece of work.

J. C. HARDWICK.

BIOCHEMISTRY—GENERAL AND PARTICULAR

Annual Review of Biochemistry

James Murray Luck, Editor; James H. C. Smith, Associate Editor. Vol. 11. Pp. ix+736. (Stanford University P.O., Calif.: Annual Reviews, Inc.; London: H. K. Lewis and Co., Ltd., 1942.) 5 dollars.

HERE we have a volume of more than 700 pages with scarcely a mention of war; there has been little diminution in the scientific production of the free peoples. It is indeed refreshing to escape into such an oasis of progress, away from the constant repetition of war news and war aims which assails us on the air and in every form of printed literature—newspaper, journal and novel.

The editor reminds us that these reviews now enter their second decade, and that they started in a period when great scientific activity was independent of severe economic depression. What a lot they have had to chronicle, what a storehouse of information for him minded to produce a book on a decade of progress! We had begun to write that the sciences covered by the elastic term biochemistry had surpassed all others in the rate of advance when we remembered that in physics the same applies.

The world to-day is largely science-conscious; the spread of education and the provision of educational facilities have borne fruit. The trained men are there, keen in their generation; the spores of new conceptions are found in the atmosphere of any college. New methods of experimentation make for quicker results, easy publication brings them quickly to the cynosure of the critical. Each step forward by one opens up the way to new advances by many. There is no prostitution of science to evil ends, for surely the man of science is free to defend his freedom with all likely weapons at hand. It is as noble to discover something of use to humanity, to alleviate sickness as to investigate something of no use to anybody. It is true that one never knows when the purely theoretical may turn up trumps, as when Lord Rayleigh's weighing of nitrogen led to the discovery of the rare gases; but this did not become less meritorious because it led to such an advance in electric lighting.

The answer is plain: let the scientific man go his own way, following his inclinations to understand and to discover; endeavour shall be his watchword. Let there be more laboratory facilities, more scholarships, more books; then the world will glean the kindly fruits of science.

There are twenty-six topics this time in the "Annual Review of Biochemistry", with many new names among the authors. The treatment varies according to the suitability of the subject for review; that is, whether it can be summarized to definite conclusions.

An interesting section is that on lignin, by Harold Hibbert, who has done so much for cellulose chemistry at McGill. The molecule is a complex one and is now held to contain propylphenol units, the union being of a carbon to carbon type involving oxygen ring formation between side chains and aromatic nuclei. The mechanism of the synthesis of phenols in the plant is also discussed: these are apparently synthesized in both the lower and higher forms of plant-life to function as hydrogen transportation, respiratory catalysts. In the higher plants, such catalysts

eventually undergo a complex series of changes to yield lignins.

The sterols are much to the fore; one review by C. W. Shopper, of Leeds, summarizes recent work on the steroid sapogenins, the cardiac glycosides and the toad poisons; another on hormones, by J. J. Pfiffner and O. Kamm, of Detroit, emphasizes in particular that relationship of structure to physiological action which is a perennial field of inquiry by chemists.

Biochemistry is advancing from the general to the particular. For example, W. D. Armstrong devotes twenty pages to the teeth under the heading of constitution and properties of dental tissues; Selig Hecht, in thirty pages, describes the chemistry of visual substances, largely the visual purple, regarded as a conjugated protein.

A reviewer can do no more than cite a few headings, avoiding the temptation to dwell on those subjects which have most appeal to him; there comes the reflection, if we only had time to read and try to master the whole. For this is what our medical advisers have to do in the future, though by then it will be presented in potted and tablet form for easy assimilation. One thing is certain, in ten years time there will be as much as ever to discover, even though all we know to-day will then appear as but the foundations of knowledge. Yet some compounds still refuse to give up their secrets: sugar, for example, has not yet been made in the laboratory.

E. F. ARMSTRONG.

SOCIOLOGY AS AN ACADEMIC DISCIPLINE

An Introduction to Sociology

By Prof. John Lewis Gillin and Prof. John Philip Gillin. Pp. viii+806. (New York: The Macmillan Company, 1942.) 18*s*. net.

SOCIOLOGY is achieving maturity as a discipline. Its increased recognition in American as distinct from most British universities is indicated by the appearance of university text-books. Whether as a subject it is in any way distinguishable from political science is a reasonable matter of doubt, depending upon whether we understand politics as Aristotle did or as something to do with politicians.

Messrs. Gillin and Gillin omit to note that the State is a modern phenomenon and that political science can scarcely be, and in fact is not, limited to study of it. They do not discriminate here between scientific and popular usage. Aristotle knew nothing like the modern State and begins with discussion of the family. It is not an issue discussed in the present volume. This overlooking of studies in political science, in the traditional acceptation of that word, deprives the book of some of the interest which it might possess, and could with advantage be remedied in a later edition.

Here we have a straightforward text-book of highly commendable lucidity, comprising chapters on population, culture, kinship groups, political constitutions, religious constitutions, social change, delinquency and crime. Some of the 'exercises' appended to the chapters raise interesting questions in the minds of those of us who recall that, for example, Prof. Laski holds (to my mind wrongly) that history and the social sciences cannot be 'objective'. For example, one 'exercise' reads: "What biases would you have to beware of if you set out to study scientifically fascism? Democracy?" What biases, one wonders, would Profs. Gillin have to beware of? Or Mr. Bernard Shaw? Or the professors of the Marx-Lenin Institute, Moscow?

Owing to the vast field covered, accuracy rather than novelty is aimed at, and the chief significance of this book, for any reader who is not a class student, is that it shows what is the shape increasingly being assumed by this subject in the ordinary teaching curriculum of two distinguished universities. It provides an admirable 'orientation' and general background for more specific studies. Discussions of methodology are reduced to one chapter. But the student who asks for an adventure of ideas in social questions will here find stimulus, and the student perplexed by issues of 'race theory', moral evolution, economic security and the like will be given perspective. As such a guide this manual will doubtless perform a very useful purpose.

GEORGE CATLIN.

PSYCHOLOGY OF WAR AND PEACE

War and the Psychological Conditions of Peace

By Dr. William Brown. A second and enlarged edition of the author's "War and Peace". Pp. viii+144. (London: Adam and Charles Black, Ltd., 1942.) 7*s*. 6*d*. net.

DR. WM. BROWN'S volume "War and Peace: Essays in Psychological Analysis" appeared in 1939, and now re-appears in a new edition with a new title. Three new chapters are added, the size of the book being thus increased by about a half. As the earlier chapters were written before the outbreak of war, and the later ones since that event, the reader has an interesting opportunity of seeing how well the author's estimate of the Nazi psychology has been borne out during the last three years. Dr. Brown's qualifications for writing such a book are unique. He has known Germany from his student days, and has kept his knowledge well up to date ever since; he is eminent in the fields of experimental psychology and psychiatry; he gained close knowledge of the psychology of the fighting man in the War of 1914–18 during his four years of active service; and he has taken the utmost pains to understand the mysterious Hitler and his hold upon the German people.

Steering clear of propaganda, and speaking only as a psychologist, Dr. Brown regards Hitler as cunning and clever, but "held firmly in the grip of his paranoid nature". To say that Hitler is only a figurehead is to under-estimate his importance as not only the creator but also the creation of his followers, whose nature is such that it dovetails into his. That there are plenty of Germans who will work for world-peace after the War Dr. Brown is convinced. Meantime the position is full of peril, and when Germany has been defeated and punished she will need re-education, in which process many highly cultured Germans of the older generation will take part honestly and thoroughly.

The general reader will find little difficulty in following the author's argument, but it may be suggested that he will do well to make some preliminary study of paranoia and paranoid tendencies in one of the best treatises on abnormal psychology. Dr. Brown's note at the end of his fifth chapter will be found helpful.

RUTHERFORD: LIFE AND WORK TO THE YEAR 1919

By PROF. H. R. ROBINSON, F.R.S.*
Queen Mary College (University of London)

"I AM sure that we all ought to . . . give some of our recollections of those past and gone before they are lost for good."

These words, written by Rutherford himself in a letter to Rayleigh (March 1936), may well serve as my text. There are in existence excellent biographies of Rutherford, as well as obituary notices in many scientific and other journals; it will therefore be unnecessary for me to attempt to give a connected account of the first forty-eight years of Rutherford's life. I shall try to mention the more salient facts, though I shall necessarily be restricted to a bare minimum of detail, but I want above all to convey, so far as I can, some impression of the atmosphere of proud and contented endeavour and achievement which he maintained in his laboratories in Manchester. I do not under-estimate the difficulty of this; Rutherford has filled so much of my mental horizon ever since I became his pupil in 1908, that I can scarcely expect to see everything concerning him in a perspective which others would necessarily recognize as true, but I will try to do it.

Fortunately, though Rutherford's genius was of a most uncommon kind, and his character and outlook difficult to assess, we have, in addition to personal recollections, one extremely valuable source of information; mainly through Lady Rutherford's care and forethought, a great part of Rutherford's correspondence has been preserved and filed. We have, therefore, expressed in Rutherford's clear and vigorous English, much first-hand information that would otherwise have been lost to us.

Rutherford's paternal grandfather, George Rutherford, a wheelwright, left Scotland in 1842 to settle, with his family, in New Zealand. His son James, born in 1839, married in 1866 Martha Thompson, who had come to New Zealand at the age of twelve, and who for a short time before her marriage worked as a school teacher. Ernest Rutherford, born on August 30, 1871, was the fourth of the twelve children born of this marriage. He was born at Brightwater (Spring Grove), not far from Nelson; four years later the family moved to Foxhill, and in 1882 to Havelock, both in the neighbourhood of Nelson. Ernest attended the State primary schools at Foxhill and Havelock, and apparently was very well taught at both schools. In 1886 he won a scholarship which took him to Nelson College, and at about the same time his family moved to Pungarehu, in North Island—not very far away—where his father, who had previously worked as a wheelwright, farmer, timber contractor and engineer, now concentrated on large-scale flax production.

Nelson College was evidently a model establishment, with an excellent headmaster in W. J. Ford and a fine mathematical master in Dr. W. S. Littlejohn, who gave Rutherford a sound start in mathematics and physics. Rutherford had a very successful three years in Nelson, winning awards not only in his best subject, mathematics, but also in Latin, French, English literature, history, physics and chemistry. It is on record that in June 1888 he was top of the sixth form in *all* subjects.

In 1889 he won a junior university scholarship which took him to Canterbury College, Christchurch, where he had again a continuous record of academic success. It was in Christchurch that he met, and became deeply attached to, Mary Newton, who became his wife in 1900.

Rutherford did his first research work—on the magnetization of iron in rapidly alternating fields—in a draughty cellar of Bickerton's laboratory at Christchurch, and later he developed an ingenious magnetic detector of electromagnetic waves. This work, which would have been remarkable enough as the first performance of a young researcher under the most favourable conditions, must rank even higher when we think of the circumstances in which it was done.

In 1895 the award of an 1851 Exhibition Science Scholarship enabled Rutherford to move to a great centre of research, and he elected to go to Cambridge—beating J. S. Townsend by a short head for the distinction of being the first research student to enrol under J. J. Thomson for the research degree newly instituted in Cambridge for workers from other universities. We find soon afterwards, in a letter to Mary Newton (October 3, 1895), "I am very glad I came to Cambridge. I admire Thomson quite as much as I thought I would, which is saying a good deal."

Here he continued work on Hertzian waves with his magnetic detector, and had notable successes in detecting waves at—for the time—great distances from their source. He soon, however (Easter 1896), dropped this to work with Thomson on the new subject of ions in gases, building up in a remarkably short time a very complete theory of gaseous conduction and determining experimentally many of the characteristic properties of the ions. From this work, by an entirely natural transition, he passed to the study of the recently discovered Becquerel rays, thereby finding his true life's work—radioactivity.

Here we may with advantage pause to recall the state of atomic physics at the time of Rutherford's first Cambridge period. It was one of almost unparalleled activity. In November 1895, Röntgen discovered X-rays, largely by accident. Becquerel's discovery of radioactivity in February 1896 was largely a second accident arising out of Röntgen's discovery. It was, of course, the use of X-ray tubes as sources of ionization that made possible Rutherford's work on gaseous conduction.

About the same time Lorentz, the great pioneer of electron theory, was able to show that the newly discovered Zeeman spectral effect could be quantitatively explained by the assumption that spectral lines were the result of radiation by charged particles the specific charge of which was of the order of a thousand times that of the hydrogen ion in electrolysis. The electron, possessing this property, was isolated by J. J. Thomson in 1897, and shown to be a constituent of all ordinary matter—and this may be taken as the starting point of the modern electrical theory of the atom. The charge of the electron was measured soon afterwards by Townsend, Thomson and others; another essential link in the chain of discovery was Townsend's brilliant work on the diffusion of gaseous ions, which proved beyond doubt that the charge of a normal gaseous ion was identical in magnitude with that of a monovalent electrolytic ion.

* From the first Rutherford Memorial Lecture of the Physical Society, delivered on November 3.

To some extent, therefore, Rutherford's entry into radioactivity and atomic physics was an accident of time and place—but this is the last occasion on which we can speak of any element of chance in his life's work. From this time on, he made and pursued his own line, and it would scarcely be an exaggeration to say that his subsequent achievement would have been little less imposing or significant if, in the whole period with which we are concerned, he had been completely oblivious to everything that went on outside his own mind and his own laboratory.

In 1898, when in full career, Rutherford made the difficult decision to leave Cambridge for the Macdonald research professorship of physics at McGill University, Montreal. Rutherford's estimate of himself at this time (which was clearly much less high than that which Thomson had formed) is quaintly expressed in a letter to Mary Newton. "It sounds rather comic to myself", he says, "to have to supervise the research of other men, but I hope I will get along all right." To anyone with the least knowledge of Rutherford's career, it must seem more than "rather comic" that Rutherford should have harboured such doubts. Even much later still, with an immensely fruitful period behind him, he showed himself inordinately gratified that foreigners like Hahn and Godlewski should think it worth while to go over to Canada to work with him.

The outstanding advance made in the McGill period was the development of the disintegration theory of radioactivity, first advanced by Rutherford and Soddy in 1903. By the time Rutherford left Montreal for Manchester, in 1907, this theory had been established beyond all reasonable doubt, and many of the details of the sequence of transformations had been elucidated. Rutherford had fully established, in his own mind at least, the nature of the alpha particles and had made rough measurements of their velocities and specific charge. He had also measured, with Barnes, a number of heating effects. His fame was now securely established, and he made of his laboratory what its founder had always hoped it would become, a permanent centre of research in Montreal. Higher education in Canada owes much to Rutherford—an indebtedness which has been generously and repeatedly acknowledged. On his side, Rutherford was at least equally ready to point out that the benefits of his association with Canada were by no means one-sided.

Rutherford's invitation to Manchester was largely due to the foresight of Arthur Schuster, who had marked him down some time before as the successor he would wish to see in the Langworthy chair of physics. Schuster was, for a physicist, a wealthy man—a fact on which Rutherford commented naïvely in a letter to his mother soon after his arrival in Manchester. He was, moreover, like so many of his race, not only generous, but also generous with rare discrimination, and when he retired to make way for Rutherford, he endowed, out of his own pocket, a readership in mathematical physics—the one thing needed to complete the strength of the department. The Manchester laboratory was, for its time, well designed and equipped, and could produce adequate supplies of liquid air. It was less well fitted than McGill for radioactive research, but Rutherford was never a stickler for luxury in working materials, and Feather has recorded in his biography that on June 6, 1907—less than three weeks after leaving Montreal—he was setting up an emanation electroscope in his new laboratory.

He was lucky in the men he found in the Manchester laboratory, most of whom turned over to work in radioactivity. He was perhaps most fortunate in finding Hans Geiger, a young graduate of Erlangen who had already done research under Schuster, and William Kay, a young mechanic who soon afterwards became head steward of the laboratories. To Kay, who surely ranks high among the world's greatest laboratory stewards, must go the credit for much of the smooth running of the laboratory.

Geiger was a well-trained and capable all-round physicist, with a considerable command of experimental technique, and his enthusiastic collaboration proved invaluable to Rutherford from the outset. Rutherford and Geiger's electrical counting of alpha particles—an amazing technical feat in those days—was completed within a few months of Rutherford's arrival, and the paper was read before the Royal Society in June 1908, with that on the total charge carried by the particles.

An acute shortage of radioactive material in the laboratory, which faced Rutherford on his arrival, was soon relieved by a generous loan of 450 mgm. of radium bromide made to him by the Vienna Academy. Shortage of apparatus became rather serious as the work of the laboratory rapidly expanded, but no doubt Rutherford at this stage in his career had no difficulty in tapping a number of sources for research funds. Dr. Norman Smith, Registrar of the University of Manchester, has been kind enough to get for me the details of the annual grants made for apparatus and equipment to the Physics Department throughout Rutherford's tenure of the chair. For the pre-war years, these (excluding amounts earmarked for electrotechnics) averaged less than £420 a year, and in 1915–19 they dropped far below this figure. With these grants Rutherford worked wonders, and there can be few instances in the history of science of comparably rich yields from such modest investments.

Rutherford attracted to Manchester many experienced workers from other universities, and by now he had learnt to see nothing abnormal in this. He was so full of ideas for work that he needed every man he could get, and he trained as many as possible of his own students for research—it being quite usual for an undergraduate to begin on a selected problem in his third year at the University. Geiger, appointed research assistant, took over much of the training in radioactive measurements, and the training course was substantially that described in Makower and Geiger's "Practical Measurements in Radioactivity", published in 1912.

Rutherford's most fruitful contribution to general atomic physics arose directly out of the results of an experimental problem which had been given to Ernest Marsden, one of the first of the Manchester trainees. This was the work on large-angle α-particle scattering, carried out mainly by Geiger and Marsden in collaboration. As Rutherford put it many years later, "I told Geiger that young Marsden should begin a research. Why not let him see if any α-particles can be scattered through a large angle? I did not believe that they would be. . . . It was quite the most incredible event that has ever happened to me in my life. It was almost as incredible as if you fired a 15-inch shell at a piece of tissue-paper and it came back and hit you" ("Background to Modern Science" (1938)). Thus originated Rutherford's nuclear theory of the atom, which he worked out in masterly fashion in 1911, and which changed the

whole face of modern physics. The picture of the atom was completed by Bohr who, after working for some months in Rutherford's laboratory, first applied new quantum principles to the electrons of the nuclear atom, and by Moseley's brilliant work on the X-ray spectra of the elements, begun in Manchester in 1913.

It was characteristic of Rutherford that, though his research school was almost completely dispersed by the War of 1914–18, and though his time was so fully taken up by work of national importance at home and abroad, he should have contrived during those years to carry through successfully yet another epoch-making research. In experiments which he began in 1917 and ended early in 1919, generally with Kay alone to help in setting up apparatus and counting scintillations, he succeeded in showing that the nitrogen nucleus could be disrupted by the impact of a swift α-particle, with the emission of a hydrogen nucleus. This, the first detected example of 'artificial transmutation', was the last work he published from Manchester; its further development belongs to the second Cambridge period.

When I, as a young student, first met Rutherford in 1908, he was at the height of his powers—as he had indeed been for many years and as he remained right to the end of his life. I am sorry that I was not one of that generation of students of whom Rutherford wrote to Boltwood in October 1907, that "I find the students here regard a full professor as little short of Lord God Almighty". I can, however, testify that this was how Rutherford was regarded by the men of my year and those who followed us, though he was mistaken in believing—if he really did believe—that all full professors were objects of reverence to their students.

Officially, honours students had no lectures from the professor in their first year, but in practice we used regularly to attend his elementary lectures, partly because they were really illuminating, whatever their topic, and partly for the beautiful, and often sensational, experiments which Kay prepared for them. It seemed at times that it was Kay's taste in lecture demonstrations that really dictated the course of a lecture, and sometimes—not often—Kay was called upon to act as prompter, in response to appeals in which Rutherford presumably believed that he had reduced his normally huge voice to a scarcely audible whisper.

We also at times saw Rutherford walking along the corridors, singing lustily a tune recognizable as a rendering of "Onward, Christian Soldiers", and later we knew this to be a sign that research was going particularly well. I was interested to learn many years later, from an article by Prof. Norman Shaw, that this, I believe quite unconscious, habit dated from the McGill period. In less favourable times there was a melancholy dirge which no one ever identified—partly because, for obvious reasons, it was considered tactful to let him have the corridor to himself on these occasions, which were fortunately very rare.

We saw Rutherford in his most inspiring form at the physics colloquium, which met on Friday afternoons, the meetings being preceded by an enormous tea-party at which Lady Rutherford generally presided. Rutherford always addressed the first meeting of the session, giving with obvious enjoyment a summary of the main work done in the laboratory during the preceding session. The attendances were large, as many of the chemists and mathematicians came over to hear Rutherford, and in the atmosphere of sustained enthusiasm which he created, no young student could fail to feel that he was highly privileged to be of that community. I think we all felt then that we were living very near the centre of the scientific universe, and maturer reflection has only served to convince me more strongly that we were right. This sense of privilege naturally grew stronger in those who went on to do research, even in those of us who were doing relatively humble tasks and not, like Moseley, the things that were going to matter fundamentally for years to come.

I should like to state some of the more obvious reasons for Rutherford's extraordinary power as a leader of research. First, of course, there was his own unique and apparently almost intuitive grasp of the essentials of a problem. Next, his interest in the course of an investigation and his impatience to know the result were so passionate that they inevitably infected even the laziest of his co-workers. Then there was his incorrigible friendliness to even the least worthy of his research men; a man who is invited regularly to Sunday supper at his professor's house, who meets him nearly every day across the laboratory tea-table, who is generally treated as the social equal of an emeritus professor, and who is constantly and pointedly asked how his work is getting on, is likely to do more and better work than one who is left to feel that nobody wants him or his results very much. No doubt Rutherford's friendliness was partly due to his upbringing in New Zealand, and enhanced by nine years of life in Canada; no one who has seen much of New Zealanders in the mass can have failed to recognize that they are an unusually friendly and companionable people. Rutherford had these qualities in an extraordinarily high degree, and they undoubtedly helped to keep things going in the laboratory.

I would emphasize, too, in this connexion Rutherford's obvious and enormous delight in experimentation. I remember once, after he and I had wasted the whole of a fine Saturday afternoon in a quite ineffectual attempt to purify a very dirty little sample of radon with which we had hoped to work, Rutherford's saying with obvious sincerity, as he sucked contentedly at his pipe, "Robinson, you know, I *am* sorry for the poor fellows that haven't got labs. to work in!" It is not really surprising that in such an atmosphere a man like Andrade, arriving fresh from work on ionization in flames and from the making of metallic single crystals, should have found himself in next to no time working on gamma-rays, or that Darwin, the second of the Schuster Readers, coming under contract as a mathematician, should have suddenly found himself involved with gold-leaf electroscopes and an experiment on a branching radioactive series.

This lecture began with a quotation from Rutherford. It may fittingly end with a quotation from von Helmholtz, part of an address given sixty years, almost to the day, before the death of Rutherford. Von Helmholtz was speaking of his own great teacher, Johannes Müller, and after referring to the student's need for "daily mental intercourse with teachers from whom he learns something of the workings of the thoughts of independent minds", he goes on to say, "Anyone who has once come in contact with one or more men of the first rank must have had his whole mental standard* altered for the rest of his life".

* von Helmholtz, "On Academic Freedom in German Universities", 1877 (Atkinson's translation). The literal translation is "mental measuring-rod".

RECOVERY OF METALS FROM SCRAP*

By SIR HAROLD HARTLEY, C.B.E., F.R.S.

THE dominant feature of industrial development in the nineteenth century was the use of power, but closely associated with it and of scarcely less importance was the enormous increase in the use of metals made possible by metallurgical progress. In 1800, for example, the world production of iron and steel was about half a million tons; in 1900 it was forty million tons, and now is more than three times as great. This rapid growth in the use of metals made serious inroads into the world reserves of ores, and in some countries the available resources, particularly of the richest ores, were exhausted or seriously depleted; so that the problem of conservation has become urgent, and with this lies a close connexion with the question of the ultimate fate of metals in use and their recovery as scrap. To what extent are they lost in use? Do they, in fact, follow man-made cycles like the well-known carbon and nitrogen cycles in Nature, so that the world stock is not in fact depleted?

Unavoidable losses in the use of metals or alloys due to wear, corrosion, heat and dispersal dissipate them so that they cannot be recovered; similarly, their use in chemical compounds such as pigments tends as a rule to total loss. The only examples of metals in which there is little such wastage apart from their use in plating or in thin films are the so-called precious metals, gold, silver and the platinum group. An exact study of the fate of the industrial metals is impossible owing to the lack of accurate statistics and to the uncertainty as to their secondary uses, but it is clear that in this century scrap is playing an increasingly large part in metal production and must enter into any comprehensive survey of world metal supplies in the future.

In the United States, for example, it is estimated that in recent years (1929–38) ferrous scrap has amounted to 75 per cent of the output of steel, while non-ferrous scrap has accounted for 50, 45 and 35 per cent of the total domestic consumption in all forms of copper, lead and aluminium respectively.

Each metal presents a different problem according to its nature and uses, but there are certain general aspects to be considered first in order to clarify so far as possible a somewhat confused picture.

Definition of Scrap

The word 'scrap' is used here to cover what are often described as secondary, reclaimed or runaround metals. Obviously there are different types of scrap which may be defined to indicate their origin as:

1. *Process scrap.* Scrap arising in the production of a finished or semi-finished article which is re-used in the plants of origin. This includes ingot heads, gates and risers from castings, crop ends of rolled material, trimmings from sheets, tubes, etc., all of which are normally returned to the melting furnaces in the same works.

2. *Engineering scrap.* Scrap such as swarf, drillings, turnings and rejects produced in engineering shops which are usually separated from the primary production, so that this scrap cannot be so quickly absorbed. Further, its physical character and high degree of oxidation often make it difficult to use in re-melting furnaces.

3. *Old scrap.* This consists of disused material arising from obsolescence, accident and worn-out parts. Recovery of this is a skilled trade involving the breaking-up of machinery into its component scrap categories; for example, a motor-car is stated to contain no less than twenty-five different ferrous alloys and the same number of non-ferrous alloys.

It is, of course, impossible to make hard and fast distinctions between these three classes, particularly between 1 and 2, but these two classes cover new scrap, metal that has not been in service, as distinct from 3. Scrap of classes 2 and 3 may, however, easily get mixed in the process of collection before it reaches the producer again.

Disposal of Scrap

The disposal of scrap metals and their use to the best advantage is becoming more complicated each year owing to the increasing use of alloys. The whole problem would be vastly simpler if metals were used mainly in a pure state, or admixed in the case of iron with carbon alone. In many cases, for example bearing metals and tool steels, the alloys are kept separately in the process of collection for re-use after re-melting and adjustment of their composition, as the recovery of the constituent metals from their alloys would be a wasteful and often a difficult and uneconomical operation. The sorting and classification of scrap is therefore a matter of great importance. For process scrap it is an easy matter, as this goes straight back to its own melting furnace. For engineering scrap the segregation is relatively easy if it is properly organized in each works, but the scientific sorting of old scrap presents much greater difficulties and requires careful organization to avoid waste. The higher prices paid for special alloys is an incentive to make the sorting as effective as possible. However, this is not so easy with small admixtures of alloy metals, and increasing difficulties are arising from the presence of these in undesirable quantities in the recovered metal.

One of the main difficulties of getting a true statistical picture of scrap recovery is the extent to which certain scrap is re-used directly without coming into the market. This applies to all process scrap and to a certain amount of engineering scrap which is recovered directly; for example, brass turnings go back direct to the brass foundry. In large organizations there is also a considerable re-use of old scrap which would not appear in any statistics. For example, railway chairs go back to the foundry, which may use as much as 95 per cent of old scrap. Bearing metals are also recovered internally and re-melted with the necessary additions of virgin metals which alone appear in the statistics. Similarly, copper scrap must reach the brass foundry unaccounted for, as the amount of copper used in brass making is less than the equivalent amount of zinc which is known to be used for this purpose.

The picture is complicated further by the re-use of suitable old scrap for the direct manufacture of other articles. For example, the re-rolling of old rails to produce a variety of articles is carried out on a considerable but unrecorded scale, and locomotive axles can be forged down and heat treated for crank pins of smaller diameter, or used for many other purposes. Small bars of mild steel can be used for

* Paper read on July 25 at the Conference on Mineral Resources and the Atlantic Charter, arranged by the Division for the Social and International Relations of Science of the British Association.

drop forgings. The re-fabrication of old scrap has been greatly helped in recent years by welding, and especially during the War has made considerable progress. Much of this re-use of scrap which makes a considerable contribution to the conservation of mineral resources does not appear in any statistical review.

Relationship between Total Production and Scrap Recovery

The volume of consumption at any moment depends on new demands and on replacements due to obsolescence, corrosion and wear and tear. It is therefore clear that unless there should be heavy accumulations of scrap or new demands had vanished in a severe depression, the amount of scrap arising from replacements must always be less than the total amounts of metal required for current production. The relation between the two will vary with the metal metal and the circumstances.

With the modern tendency to rapid development and quicker obsolescence, the life-cycle of metals will in general be shortened. On the other hand, welding has made possible the repair of steel, for example at rail ends and in locomotive fire boxes, which will increase the service life of metals. The development of improved materials with increased hardness, greater resistance to wear and fatigue, and to corrosion (including painting and surface treatment) also tends to lengthen the life-cycle and eliminate losses of metal. The use of lighter designs, the increasing use of sheet metal and of a multiplicity of small 'gadgets' may, however, tend to make scrap recovery less complete.

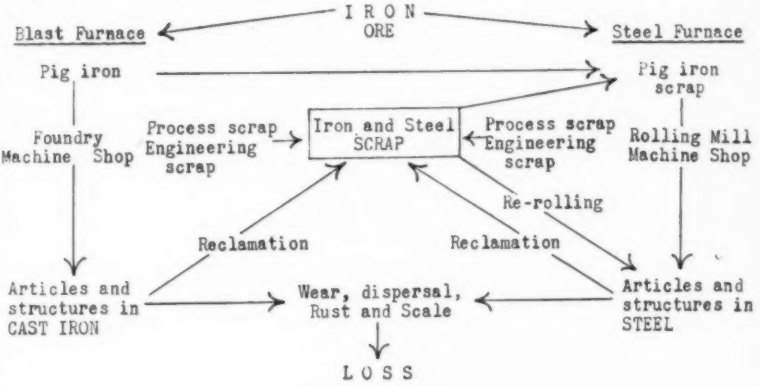
An interesting point arises in connexion with the increased use of reinforced concrete in place of steel construction. This effects a considerable saving of steel amounting to 50–60 per cent; but on the other hand it is not economical to recover much of the steel in reinforced concrete, whereas the bulk of a steel frame can be salvaged.

For iron and steel, corrosion is the biggest factor, which Speller estimates may lead to an annual replacement of two per cent of the total tonnage in use. For other metals the effect is much less, as is shown in the accompanying table giving the results of exposure of metals in the industrial atmospheres of Birmingham and Sheffield. The two sets of results are expressed differently, but the metals appear in the same order in each.

When all these variable factors are taken into account and the uncertain statistics as to the use of scrap, it is not surprising that it is impossible to draw up an exact balance sheet covering losses and recovery of any metal, as will be seen in the sections dealing with the separate metals.

Iron and Steel

At present iron and steel represent about 93 per cent of the total world tonnage of metal production.



LIFE-CYCLE OF IRON

It has been estimated that of the total output, 15–20 per cent is lost from rusting, and that in all 35 per cent is lost irrecoverably due to rust, dispersal and the use of iron and steel in articles from which recovery is uneconomic. 65 per cent is left to find its way back into use, of which 25 per cent is process scrap which does not leave the steel works, and the remaining 40 per cent returns at a rate dependent on obsolescence, wear and the state of industrial activity. With improved protection against rusting, losses will be reduced, but quicker obsolescence will shorten the life-cycle.

The following figures for recent steel production in Great Britain confirm this estimate, remembering that some scrap goes to blast furnaces and that an addition must be made to the percentage of scrap in the table to allow for this:

Year		Total production	Pig used	Scrap used	Scrap (per cent)
1935	....	9·6	4·6	5·8	56
1936	....	11·8	5·6	6·9	55
1937	....	12·9	6·2	7·5	55

The recovery of ferrous scrap in the United States has reached a higher figure in recent years, averaging 75 per cent of the steel production, possibly due to quicker obsolescence.

RELATIVE ATMOSPHERIC CORRODIBILITY OF METALS

Metal	Friend (*J. Inst. Metals*, 42; 1929). 7 years in Birmingham City air. Loss of weight (%)	Hudson "Corrosion of Iron and Steel" (1940). Sheffield industrial atmosphere. Rate of corrosion (mils/year)
Mild steel	10·3	5·0
Wrought iron	6·7	3·8
Cast iron	3·5 (approx.)	Good resistance
Zinc	0·54	0·70
Nickel	0·47	0·41
70 30 Brass (2 Pb)	0·39	0·57
Copper	0·18	0·28
Aluminium	0·11	—
Tin	0·10	—
Lead (soft)	0·09	0·26
Stainless steel (12 Cr)	0·10	—
18 Cr 8 Ni	—	0·003

The main difficulty which has arisen in the recovery of ferrous scrap is due to the increase in the number of alloys, which makes it increasingly difficult to segregate scrap of similar character. The result is that the amount of the residual elements tends to increase in ordinary steel, producing undesirable results. For example, the presence of nickel and chromium may produce a steel very different in characteristics from the steel required. Rejection has occurred from this cause, emphasizing the importance of improved methods for segregating most carefully scrap from alloy steels of various compositions, in order to utilize them most economically and to avoid the presence of elements which may upset the normal properties of the steel. The introduction of controlled grain size straight carbon steels often avoids the need for using alloy steels, and they have the additional advantage of simplifying the recovery of scrap, since they contain no other elements.

In the case of alloys with a high percentage of other elements, for example stainless steel or tool steels, the large differential in scrap price is an incentive to see that they are kept separate.

Manganese, Nickel and Chromium

There is only a small recovery of manganese in the form of high manganese alloys, as the bulk of it is used in steel manufacture as a deoxidizer and desulphurizer and is lost in the slag.

Only a small percentage of nickel is recovered, as much of it is lost in low-nickel steel alloys which go into ordinary scrap or in nickel plating. Undoubtedly more could be saved by the segregation of nickel alloys. Recovery is presumably better for the high-nickel alloys. In the United States scrap recovery has progressed steadily and in 1938 was about 2,000 tons.

Little is known about the recovery of chromium, except that its high price encourages recovery by producers and fabricators of the alloys and by large consumers. The expanding demands for chromium steels will make the segregation of chromium alloy scrap of increasing importance.

Copper

The United States statistics for copper recovery are more complete than for any other metal and so it is possible to give a clear picture of the position. Owing to its relative freedom from corrosion, wastage should be relatively small and its value is favourable for salvage.

Copper is recovered and passes into use again both as metal and as brass and other alloys, and it is important to distinguish between the two. United States statistics for 1929–38 show that, of the domestic consumption of copper metal, approximately 6½ million tons in those years, 2¼ million tons, or 39 per cent, came from scrap recovery, of which roughly one third came from new scrap (process and engineering) and two thirds from old scrap. Scrap recovery in addition yielded nearly 2 million tons of copper in the form of brass or alloys. The total contribution of recovery, therefore, to the domestic use of copper in all forms was approximately 50 per cent for this period.

The trend of scrap recovery over a period of years shows a close relation to the index of industrial production. Increasing prosperity means new consumption and the quicker replacement of obsolescent articles. Increased production means increased new scrap, and the flow of old scrap depends on the rate of replacement. Apart from stocks this flow is, in fact, a direct function of current consumption. Hence it is not surprising that the volume of scrap recovery of copper should be related more closely to the index of production than to current scrap prices. The length of the life-cycle of copper will vary with the level of industrial activity.

Tin

About half the total tin production is used as pure metal for making tinplate and as foil for various purposes. The rest is used in various alloys, solder, bearing metal and bronzes. Tin is recovered from the clean tin scrap and from the dross arising in the course of manufacture of tinplate, but the recovery of tin from used cans is not in general economical owing to the difficulty of collecting and cleaning them. There is also a considerable recovery from tin alloys. United States statistics for 1929–3 show a recovery of metallic tin from scrap amounting to eight per cent of the total consumption as pure tin and alloy, and a recovery in the alloy form amounting to 26 per cent, so that on an average one third of the consumption was provided from the recovery of scrap. About 6 per cent of the tin is used in various chemical compounds and this is irrecoverable.

Lead

The major uses for lead are storage batteries, cable covering, sheet and pipe, and a small proportion is used in alloys. The processes of manufacture are relatively simple and they result in little process or engineering scrap. Owing to the relatively large percentage of lead used in pigments, in ammunition and as tetra-ethyl lead in motor spirit, and the loss of bearing metals by wear, there is inevitably a considerable irrecoverable loss. On the other hand, the recovery from storage batteries probably amounts to 80 per cent after an average cycle of two or three years in motor-vehicles, while the cable covering is also largely recovered after a longer period of years.

United States statistics for 1929–39 show that the recovery of lead as metal produced 1,349,000 tons, one third of the total production of refined lead during that period, and that, in addition, 1,017,000 tons were recovered in the form of alloys, thus saving an equal quantity of virgin metal.

Zinc

A large proportion (probably 40 per cent) of zinc production is used for galvanizing iron to protect it against corrosion, and none of this is recovered, the zinc being sacrificed for the protection of the so-called iron, but which to-day is mild steel. However, there is a wastage of some 20 per cent of zinc in the galvanizing pot, much of which is recovered as dross, which is re-distilled for spelter or zinc dust. The next largest use of zinc is for brass-making, a considerable proportion of which is recovered and re-used. Apart from this, there is only a small recovery of zinc from the articles in which it appears in the rolled form. The United States statistics show that the recovery of zinc as metal has averaged 11 per cent of metal production, and in addition slightly less has been recovered in the form of alloys. A considerable loss occurs each year from the use of zinc in pigments.

Aluminium

There is a considerable scrap recovery of aluminium and aluminium alloys. Process scrap is usually re-melted in the works when it is produced. Engineering scrap (turnings, millings, filings, etc.), which may amount to 50–200 per cent of the weight of the finished article, requires special methods of melting to ensure both a good yield and quality and is usually returned to specialist firms, the secondary metal melters. The segregation and cleaning of the various types of scrap are of great importance.

Old scrap presents a more difficult problem, as it has to be separated into the different alloys, a skilled job requiring experience and the use of scientific methods.

United States statistics for 1929–38 show that out of a total production of one million tons of metal, one fifth came from scrap recovery. In addition, about 225,000 tons of aluminium were recovered in the form of various alloys, making the total contribution of scrap to consumption in this period about 35 per cent.

Export of Scrap

Nothing has been said yet about the export of scrap, but to secure maximum recovery there should be a flow back to metal-producing from non-producing countries. The statistics for iron and steel scrap, which are fairly complete, do show this in a few cases, such as Holland and Switzerland, but the bulk of the transfer of scrap, which averaged 5 million tons a year for 1933–38, actually took place between steel-making countries, owing largely to preparations for war. Under happier auspices the International Scrap Convention, established in 1937, might have done much to avoid this uneconomical transfer.

Conclusion

The absence of world statistics on the recovery of scrap makes it impossible to give a comprehensive picture of its full significance. However, it is clear from the data given above that scrap recovery will be of increasing importance as regards the conservation of our metal resources, and that as a major source of raw materials it must be brought into any general scheme affecting them under the Atlantic Charter.

Taking conservation first, the following measures would help towards a maximum scrap recovery and help to diminish wastage of metals: (1) The salvage of all new and as much old scrap as possible. (2) Improved methods for segregating engineering scrap of different kinds so as to avoid mixing different metals and alloys. (3) Improved methods for sorting and cleaning old scrap and identifying doubtful material by quick tests. (4) Improved methods for cleaning scrap and putting it into a suitable form for re-melting. (5) Arrangements to avoid losses by corrosion when scrap, often finely divided, is kept for long periods. (6) Avoidance of the unnecessary use of alloys, which complicates scrap recovery, and the reduction of the number of alloy specifications to the minimum necessary. (7) Improved methods for protecting metals against corrosion. (8) The re-use of old scrap by fabrication and welding.

Turning now to the inclusion of scrap metals in any general scheme for metal supplies under the Atlantic Charter, the first essential is the compilation of international statistics on an agreed basis. Even if these cannot be complete owing to the difficulty of including old scrap which is re-used by works internally, and so-called runaround scrap such as bearing metal, which circulates internally and therefore does not come into account, it should be possible to collect data for all process scrap, engineering scrap, or old scrap which reaches the market, so as to see to what extent consumption in each country can be met from virgin metal or from scrap.

The need for such statistics was emphasized in the following passage from the report of the National Resources Board of the United States appointed by President Roosevelt in 1934: "The subject of scrap is the great blind spot of the world's metal economy. Despite the importance of secondary metals no statistics of an international character can be had. The United States is the only Government compiling figures of secondary metal production. The present annual statistics of the Bureau of Mines should be established on a quarterly or monthly basis and expanded to include stocks and consumption as well as output. This is one of the most constructive steps that could be taken for stabilization of the metal industries. Until the importance of scrap is recognized, effective adjustment of supply and demand in the metal industries will remain difficult or impossible." This was written in 1935 with special reference to the United States; to-day, in the light of the Atlantic Charter, it has a much wider significance.

FAMILY SIZE AND SURVIVAL IN GREAT BRITAIN

By Dr. PERCY STOCKS

THE Registrar-General's first report on fertility, based on the data obtained under the Population (Statistics) Act of 1938, shows that in 1938 the reproduction rate in England and Wales, adjusted for the anticipated rates of survival of women and girls, must have been between 16 and 20 per cent below the replacement level, and that if a serious decline in the native-born population of Great Britain is to be averted, the rate must be raised to that extent within the next few years. Complete elimination of stillbirths and child deaths up to age fifteen would bring us within 6–7 per cent of the goal, but that is outside the bounds of possibility. The increase might be effected by less avoidance of marriage and by marriage at an earlier age, but if no such social changes as these occur, it can only come by increase in the average number of children per family.

The average citizen has little knowledge of a biological kind as to the best age for marriage and the most favourable spacing of children for the rearing of a healthy family, and even scientific men have to confess to a lamentable lack of concise information on these vital matters. It would be natural to expect, therefore, that any addition to such knowledge would be eagerly studied. Little comment has been made upon the facts revealed by the fertility report: such as the findings that 42 per cent of marital children

born in 1938 were first children, whereas only 19 per cent were born to mothers who had already had more than two, and that the risk of stillbirth was 30 per 1,000 for first-born and less than 20 for subsequent children to mothers less than twenty-five years old, whereas for first-born children it was 45 at ages 25–34 and 87 at 35 or over. Another important fact discoverable from the Registrar-General's 1938 report is that whereas the risk of maternal death when confinement occurs between the ages of 20 and 25 is only 1·5 per 1,000 maternities, it rises to 3 at ages 30–34, to 4 at 35–39 and to 6 at 40–44. The risk of a stillbirth increases from 28 per 1,000 births when the mother's age is 20–24 to 3?, 39, 54 and 70 at succeeding age groups of five years. For young mothers under 20, both risks are slightly greater than at 20–24. Here is an important fact which should be stressed, namely, that the dangers to both mother and child are least when confinement occurs between the ages of twenty and twenty-five.

The Population Act statistics can tell us little about the survival of live-born children according to family size and maternal age, and we have little reliable data on this point since the census of 1911 ; but this gap has now been partly bridged by a study of the records of health visitors of the maternity and child welfare area of the Administrative County of Durham for the years 1930–37 by Mrs. C. M. Burns*.

This book needs careful study, for not all the conclusions, even when in the heavy type liberally used, can be accepted as proved by the data tabulated. From the point of view of survival up to five years, the report shows that first, second and third children are best born while the mother is between twenty and thirty-five, whereas fourth and fifth children have a better chance if born to mothers of 35–39 than if born to younger mothers ; but the attempt which is made to prove that the latter finding is not the result of some form of social selection is not entirely convincing.

Nor can the evidence for the statement that "high death rates are more dependent on the size of family than on the housing conditions, as measured by rooms per person or rooms per family" be accepted as conclusive. First children of miners born to mothers aged 20–29 and housed at average densities of 1·1 and 1·8 persons per room respectively suffered losses before the fifth birthday of 147 and 143 in each 1,000 live or stillborn, whereas miners' sixth to ninth children born at any age of the mother and housed at average densities of 2·2 and more than 3 per room respectively suffered losses of 201 and 238 per 1,000. But no effect of overcrowding on health would be expected until the density exceeds about two persons per room, so the equality of the first two rates proves nothing ; and the rising rates in the last two groups may as well have been due to overcrowding as to rapid breeding, these being so inseparably connected as to defy any statistician to disentangle them. It has long ago been demonstrated from the national statistics that mortality of children aged 1–5 years is more sensitive to environmental conditions than is infant mortality, and there can be little doubt that the presence of five other children in an overcrowded home is more likely to enhance the risks to a young child from most infective diseases than the presence of an equal number of adults.

The evidence that longer spacing between births results *per se* in better survival seems to have been based mainly upon a comparison of 119 sixth children born to mothers aged 25–29, of whom 28 or 23·5 per cent failed to reach their fifth birthday, with 353 sixth children of mothers aged 30–34 whose non-survival rate was 17·6 per cent, and upon similar differences in survival of the five previous children. This is slender evidence on which to base a far-reaching conclusion. That rapid breeding and overcrowding are each deleterious to the survival of young children may be accepted from the evidence, but it remains unproved which of the two is the more important.

The method of basing 'death-rates' of children upon the original number of live and stillbirths of which they were the survivors may lead to strange fallacies, such as the conclusion that twin children who have survived the first year thereafter "display quite normal death-rates". The data show that 414 per 1,000 twins failed to survive a year compared with 112 per 1,000 single born, and that the 'rates' at 1–4 years were 27 and 31 respectively ; but if based upon the numbers at risk to die, the true rates at 1–5 years were 46 and 35 per 1,000 respectively, which shows the conclusion to be fallacious.

A conclusion which must occasion surprise is that in small families of one, two or three children "the fall in infant death-rates during this century has been very slight". It is deduced from the 1911 fertility report, by what method is not stated, that infant mortality in 1905–10 in families with one child was then about 55 per 1,000. Actually for marriages of 2½ years average duration, 62 per 1,000 first children born alive were dead at the census, and since the average interval between marriage and the first child, when that child was born in the first five years, was 1·63 years in 1938 according to the recent official report, and is unlikely to have been less than 1·5 years in 1905–10, the original figure 62 seems a more probable estimate for mortality of first children within a year than 55. By applying the Durham infant mortality-rates for children of successive birth ranks to the distribution of 1938 births in England and Wales according to birth rank, it can be estimated that the rate for first-born children was then about 92 per cent of that for all children (53), which gives 49 as the 1938 rate among first-born. Although a fall from 62 to 49 can scarcely be described as "very slight", it is small compared with the 50 per cent drop in the total infant mortality-rate, and Mrs. Burns has at least succeeded in showing that a large part of the improvement in infant and child survival in Great Britain on which we are apt to pride ourselves must have been due to the reduction in average size of family.

Mrs. Burns has produced with great industry a work so challenging that it will be widely quoted, and for that reason it has been deemed important to put those who study and use it upon their guard against its faults. If it is unnecessarily gloomy we shall not quarrel with it on that account, for it contains much information which is unique and timely. The fertility position has got to be faced, and we cannot hope to apply the right remedies without a diagnosis of the causes. It is cheering to read in this report, based as it is upon conditions in a depressed area, that : "If marriages take place early enough it would be quite easy to produce a fairly large proportion of well-spaced families of four, five or even six children under the best 'biological' conditions".

* Infant and Maternal Mortality in relation to size of Family and Rapidity of Breeding : A Study in Human Responsibility. By C. M. Burns. (King's College, University of Durham : Department of Physiology, 1942.) 5*s.* post paid.

PUBLIC HEALTH IN GREAT BRITAIN

By SIR GEORGE NEWMAN, G.B.E., K.C.B.

FOLLOWING precedent in time of war, the Ministry of Health under the vigorous leadership of its Minister, Mr. Ernest Brown, has just issued a "Summary Report" on the public health of Great Britain from April, 1941, to the end of March, 1942* ; this is instead of the usual annual statement by the Chief Medical Officer. It is recognized that war has the effect of re-distributing the population, affecting the incidence and mortality of disease, and producing a variety of emergency services of a temporary nature (evacuation, raid shelters, and the care of the homeless). Nevertheless, it is highly satisfactory that the health of the people of Great Britain has been more than maintained ; and this indeed has contributed substantially to the war-effort itself. This high standard is attributed largely to the improvement made in matters of health, housing, nutrition, and the wider general public services accomplished in the last two decennia. "It owes much to the improvements in housing, health and other social services that were made between 1919 and 1939, and also to all that was done during the same 20 years to educate the public in health matters." The schools of all grades, the public newspapers, the B.B.C., and the most admirable work of the Ministers of Food and Agriculture in regard to rationing, agricultural development, and domestic application, each of which is a national science and art, have co-operated ; and at the back of it all, and inspiring it all, there has been an expanding public appreciation of what is at stake in the cause of freedom. In fact, this is one of the outstanding agencies serving as a lively stimulus of public opinion ; developing a sense of devotion and service, and of mutual interdependence, necessary to a State that is set on winning a war ; this 'something' is a kind of generative 'human credit', something to bank on, which when it grows in volume and extent inevitably leads to triumph of a constructive kind of statecraft.

Consider this astonishing fact. In the midst of the international struggle which has involved us all, and all our affairs down to the smallest detail, the English people have re-discovered their sense of solidarity and essential unity in purpose, with its consequent demand on their service, not only in the fighting line but also in what has come to be thought of as the 'home front', in maintaining the fundamentals of civilized life in Christendom, and its ordinary decencies. It is most impressive and enheartening. Instead of capitulating to the monstrous demands and outrageous policy of a group of gangsters, they have suddenly found themselves and their own soul. Life is after all not hedonistic ; nor is it the common thing which they had assumed, but a great and even glorious adventure. Are we really to suppose that Russia, and America (north and south), and China (which has come down through the ages), as well as Great Britain and her Dominions, are under some delusion that a monomania of Hitlerism and his New Order is the last word in human civilization ? If so, it is a grave misapprehension.

The redistribution of population in Great Britain due to the War called for sacrifice, both from the evacuated and those who received them. The local government service accepted the strain of the duty thus imposed upon it, and its reputation for efficiency and devotion was if anything enhanced ; by 1940 and 1941, accommodation had been organized for 3 millions in public and communal shelters and 4½ millions in Anderson shelters. The absence of 'alerts' towards the end of 1941 relieved the Ministry of a most exhausting effort, central and local, and allowed it to attend to the routine duties of health.

The general health all through 1939–42 has remained excellent. The total death-rate was 12·1 per 1,000 in 1939, and 12·9 in 1941. The *infant mortality*, which by 1939 had been reduced from the 'homicidal' figures of earlier years (such as 150 per 1,000 from 1870 to 1900—involving the loss of 140,000 infant lives yearly) had come down to 90 in 1916–20 and to 60 by 1930 (that is, a loss of 38,000 children) and was in 1939 so low as 50, moving up in 1941 to 59 (representing 34,000 deaths of children less than one year of age).

The *maternal mortality*, as is well known, changed for the better in 1934. Before that date, Great Britain had been acquiescent in losing the lives of 3,000 every year, but in 1932 the figure declined to 2,500 and in 1940 to 1,640. This meant a fall in the maternal mortality from upwards of 4 or 5 per 1,000 to 2·6, the lowest on record. This welcome and extraordinary reduction is rightly attributed to improved midwifery, and especially to an improvement in the treatment of puerperal sepsis, by the use of sulphonamide. How was it done ? The answer is clear. The fall in the infant and maternal mortality was due to *better motherhood* and better midwifery practice. In other words, the physical functioning of motherhood is not hereditary, but must be learned by each mother ; and three or four years ago it was discovered, medically, that by the wise use of sulphonamides puerperal fever might be reduced. The State and voluntary agencies did their part for mothers and children by establishing infant welfare and ante-natal centres where the art of midwifery and the care of infancy might be taught ; 3,600 of these centres were established by local authorities or voluntary agencies by 1941, and they were attended by 70 per cent of all the babies born alive in that year. There were also 1,800 ante-natal clinics, and many hundreds of health visitors visited in the homes. The National Milk Scheme provided free milk for mother and baby, and eggs, free oranges and lemons, or orange juice, blackcurrant juice or purée, and cod liver oil. The Government also provided many new nurseries and contracted for others, and by March, 1942, there was new accommodation for 11,400 children ; and in addition there were 2,000 hostels provided for mothers or children, or both. The exaggerated talk about 'malnutrition', before the present War began, has died down, and what has been said here shows how keenly interested the Government has been in protecting the mother and child from any degree of under-nutrition. Investigations show nothing disquieting ; indeed the reports from many districts show evidence of improvement.

Owing to the rise in the incidence and mortality of *diphtheria* the Ministry has urged the public to have children immunized against this infection. In 1941 a campaign was initiated by Sir Wilson Jameson, broadcasting the favourable experience of New York in this matter, and up to June, 1942, upwards of three million children in Britain had been inoculated.

* Summary Report by the Ministry of Health for the Period from 1st April 1941 to 31st March 1942. (Cmd. 6394.) Pp. 35. (London : H.M. Stationery Office, 1942.) 6d. net.

It is curious to remember that England, the home of vaccination against smallpox, is slow to practise immunization. It waited fifty years, and lost many lives, before it used its own inventions; similarly with diphtheria and typhoid. *Tuberculosis* also has been a cause of anxiety owing to an increase of 23 per cent among industrial young women. The avoidance of droplet infection, the use of pasteurized milk, and miniature radiography in diagnosis are recommended.

Venereal disease is a still more complex problem, which tends to increase in importance in war-time. The Royal Commission of 1916 elucidated it and directed attention to the importance of early diagnosis, free treatment, the use of Salvarsan or its derivatives, and the prohibition of quack advertisements, false remedies, and unqualified practice. It also advised widespread public education, and numerous clinics, of which some two hundred were established. In March of the present year, the Central Council for Health Education was authorized to assist in the necessary educational work (see also NATURE, Nov. 7, p. 529). Notification of venereal disease was not recommended in 1916, as it tends to drive the disease underground; but its present tendency to rise in incidence is full of warning as to the need for alertness and vigilance. The reaction of the Ministry of Health to the problem is seen in a Defence Regulation (33, B.) issued on November 11 (since the "Summary Report" was published) announcing that, particularly because of the presence of numbers of service men and women from countries where treatment of venereal disease is compulsory, treatment is now made compulsory in Great Britain.

Happily this is not all. For the Minister of Health has an eye to the future reconstruction of the public health services, and his advice on this subject is much to the point. The prior aim to meet the admitted needs of mothers and children, which has proved itself most effective, is not enough; and in 1941 the Minister laid down the principles of his particular "New Order". There must be no return after the War to the confused and unrelated hospital services pursuing independent, wasteful, and competitive courses; the hospital business must be *planned* as a whole into a comprehensive and adequately integrated national service by which everyone in need will actually receive appropriate and prompt treatment. This is to be undertaken by the larger local authorities (in close co-operation with the smaller) and in recognized co-operation also with the voluntary hospitals in areas substantially larger than those of existing local authorities. This meets the new demand for regionalization. Further, the Exchequer should give financial help, especially to hospitals undertaking the teaching of medical students or the highly specialized services of medicine, surgery and practical midwifery. To this end the Minister of Health has instituted a system of survey of the present administrative situation, beginning in the London district, and also an inquiry into organization of the medical schools, and their arrangements for clinical teaching and research. Such inquiry will not include the curriculum of medical training, already provided by the General Medical Council under Act of Parliament. Nor has the Minister lost sight of two new spheres of applied medicine, industrial and rehabilitation. We must complete our medical treatment (vocationally or otherwise) by following up effectually our remedy, so that the industrial worker who has been disabled may be returned to his job fit to continue his work, or any new work to which he may be transferred. All this is very timely and hopeful; and it envisages a long-felt need for co-operation with medicine of the rehabilitators, the vocationalists, and the medical specialists.

NEWS and VIEWS

Dr. D. R. Pye, C.B., F.R.S.

DR. DAVID RANDALL PYE, formerly fellow of Trinity College, Cambridge, and of New College, Oxford, has been appointed to succeed Sir Allen Mawer as provost of University College, London. Dr. Pye, who has been for many years connected with the scientific side of aeronautics, succeeded Mr. H. E. Wimperis as director of scientific research to the Air Ministry, which appointment was transferred by a war-time change to the Ministry of Aircraft Production. In this position he has had control of a large scientific and experimental staff, principally at the Ministry's London headquarters, the Royal Aircraft Establishment at South Farnborough, and the Aircraft Testing Station at Boscombe Down. He has also worked in collaboration with the Aeronautical Research Committee, and the National Physical Laboratory, Teddington, and has been responsible for maintaining the high standard of scientific aeronautical research in Great Britain.

Dr. Pye's own original scientific work was on the internal combustion engine, and he is the author of a standard work in addition to many papers on this subject. His administrative work at the Air Ministry has covered all the other branches of work associated with the development of aeronautics, and the production and use of aircraft in the widest sense. He was elected a fellow of the Royal Society in 1937, and is a past vice-president and member of the Council of the Royal Aeronautical Society. He is also one of the general editors of the Oxford Engineering Science Series of works.

Akbar, the Great Mughal

ON November 23, 1542, Akbar, the future Mughal Emperor, was born at Amarkot. His father, Humayun, had already lost the kingdom won by Babar, and Akbar's childhood was spent in exile. Humayun reconquered India in 1555, only to die, and the boy-king had to endure five years of regency before he came into his own. He stands out among Asiatic rulers as a determined leader and enlightened organizer. But the man was greater than the king. His interest in religion and philosophy, art and science is famous, but the distinguishing marks of his greatness were the questing intelligence and fearless judgment he consistently brought to bear upon the difficulties with which he was surrounded. He set himself to unite Hindu and Muslim India. He married into the ancient Rajput royal families, and

Jahangir, his successor, was born of a Rajput princess. It is worth remembering that his reign coincides almost exactly with that of Elizabeth of England. At a time when Europe still found the methods of the rack and stake acceptable, he instituted and enforced religious toleration. He grappled with the horrors of suttee two hundred years before Bentinck abolished it. He was the patron of learning and the arts. His justice knew no distinction of caste or creed or colour. Such was the man, who, while he lived, united India in mutual service. The fourth centenary of Akbar's birth will be celebrated by a meeting arranged by the British Council, the Royal Asiatic Society, the East India Association and the India Society to be held in the rooms of the Royal Society on November 23.

Discovery of a Nova

A TELEGRAM from Lund announces the discovery of a nova, magnitude 2, by Finsler and Nakahara. It is about 5° north of ζ Puppis. The telegram is dated November 13, but the time of discovery is not stated. Before receiving the telegram a telephone message which was sent by Mr. G. Ellis, Llandudno Junction, was received at the Royal Observatory, Greenwich, and this announced that Mr. Ellis, observing from a height of 400 ft. above sea-level, had discovered the nova on Nov. 13d. 4h. 25m. U.T., its approximate position being, R.A., 8h. 10 m., Dec. − 34°. Owing to its high southern declination it will not be an easy object to see in Great Britain. It crosses the meridian about 4h. 15m. U.T. on November 21, and in the latitude of Greenwich its greatest altitude does not exceed 4·5°. Mr. Will Hay has reported that he has observed the nova with the naked eye.

Documentation and Microfilm

THE *Proceedings of the British Society for International Bibliography*, Parts 1 and 2, contain the papers and discussions at the twenty-second and twenty-third ordinary meetings on March 5 and April 23 last, respectively. In Part 1, Miss M. Shaw's paper "Documentation in an Industrial Laboratory" describes the library and information service in the laboratories of Messrs. J. Lyons and Co., Ltd. The function of this library is to keep the chemical staff supplied with the most recent scientific and technical literature, to see that this is adequately catalogued and indexed, and to supply information, as well as prepare bibliographies and translations. Any books borrowed must be in the laboratories during the day so that they are available for reference if required. With regard to abstracting, the actual reading of the periodicals and selection of matter to be indexed is carried out by the chemists themselves, the periodicals concerned being issued to the sections of the laboratory in turn, for periods of 2–3 days, and 7 days for the final section, which is responsible for noting anything missed by other sections. Indexing is carried out daily in the library before re-issuing a periodical. For copying scientific papers, the Lumiere – Van der Grinten diazo process is used and has given very satisfactory results since July 1938.

Part 2 of the *Proceedings* contains a paper by B. K. Johnson describing four pieces of apparatus for use with microfilming processes. These consist of a hand viewer for the recognition of titles and general identification of the film, a viewer for table use, a microfilm projector for use by the typist when typewritten copies of a document recorded on microfilm are required, and a camera for the photography of documents, etc. In a written communication in the discussion, Mr. E. H. Lindgren stressed the importance of proper safeguards in the storage of the film and referred to an intensive technical examination of the films in his possession which is being carried out with the view of obtaining fuller information on the storage question. Mr. K. S. Smith's paper in the same part describes the airgraph service, Mr. H. J. Dowden the Gesteprint process for duplicating foreign periodicals, etc., in which the stencils are prepared by a photographic process, and a paper by H. Rottenburg on "The Typewriter as the Foundation of the Printed Book" outlines the possibilities of replacing printer's type by a typewriter and discusses the advantages.

Polarography

POLAROGRAPHIC methods continue to attract attention in Great Britain. Much knowledge has already been obtained and a concise summary of this, written in a simple objective manner, is to be found in a pamphlet, "Cambridge Polarograph", recently published by the Cambridge Instrument Company. For its size this pamphlet covers a great deal of ground and, if the theoretical background of polarography is largely omitted, this is compensated for by the presence of a considerable bibliography which contains references to most of the important papers on the subject. The difficulties of the polarographic method are not unduly emphasized; nevertheless, most of the major pitfalls are mentioned and it is frequently made clear that modifications of technique must be very critically tested. Use of the polarograph for the performance of amperometric titrations has not been overlooked.

A relatively small part of the pamphlet is devoted to a description of the Cambridge polarograph, and it is a pity that a wiring diagram of the instrument is omitted. Clearly, however, satisfactory electrical equipment is provided in a compact form to meet the needs of a present-day user of the polarograph. The text of the pamphlet is well illustrated with reproductions of actual polarograms, which give a very fair idea of the possibilities of the instrument and will no doubt stimulate the efforts of new users of the Cambridge polarograph. A table and chart of the half-wave potentials of inorganic substances, and the bibliography already mentioned, add to the value of the publication.

Spectroscopy in Astrophysics

DURING a conference on spectroscopy arranged by the University of Chicago on June 22–25, several papers described results of recent research with the aid of the spectroscope. A short account of these papers is given in *Sky and Telescope*, September, by Dorrit Hoffleit. Dr. Andrew McKellar, of the Dominion Astrophysical Observatory, has made a critical study of the intensities of bands in the spectra of Comet Hassel (1939*d*) and Comet Cunningham (1940*c*). These bands correspond to temperatures ranging roughly from 200° to 2,000° K., and further research is desirable to explain this anomaly. The use of the spectroscope in settling the composition of planetary atmospheres has been followed by numerous theories to account for the diversity in the atmospheres of the planets, assuming that they all

started their evolutionary course as homogeneous fluid masses with temperatures of several thousand degrees. Dr. Rupert Wildt discusses this problem in an interesting paper, but, as might be expected with a subject of such complexity, there is a large amount of speculation in his theories. Dr. C. T. Elvey reports on spectrophotometric and photo-electric studies of the night sky, and discusses the permanent or 'non-polar' aurora, which is much less spectacular than the better known northern or southern lights. The spectra indicate that atoms or molecules of oxygen, sodium, nitrogen, nitric oxide, water, and sometimes ionized nitrogen are involved. Spectrophotometric studies, in which Dr. Alice Farnsworth collaborated, refer to radiations originating about 800 miles above the earth's surface. Photo-electric observations concern radiations from altitudes of about 200 miles. Infra-red observations of the intensity of the light of the night sky show that there is sometimes a steady decrease throughout the night, and also that such observations are associated with times when terrestrial magnetic activity is low. It is suggested that this regular variation may be explained on the theory that the radiation is caused by the release of energy when oxygen atoms combine to form oxygen molecules.

Recent Earthquakes

AN earthquake with epicentre in the Songea District (Livingstone Mountains) near Lake Nyasa, Tanganyika, was reported from Dar es Salaam on November 8. It is said to have been the most serious for many years and wrecked many buildings and a Roman Catholic mission. Damage is estimated to have been near £3,000. No casualties have been reported.

Dr. Perry Byerly of the University of California reported the registration of a very large earthquake by the seismographs at Berkeley at 8.2 a.m. Eastern War Time on November 10. The epicentre was estimated to have been 9,500 miles from Berkeley.

During October 1942 only two important earthquakes have been registered by the seismographs at Kew Observatory. These were on October 20 and 26, respectively. The former began recording at 23h. 35m. 55s. U.T. and attained a ground amplitude of 195 μ at 00h. 27m. 06s. on October 21. The epicentral distance from Kew may have been 11,200 km., but the analysis is tentative since the record was interrupted by large microseisms. The latter began recording with compressional *iP* on all three components at 21h. 21m. 19s. U.T. and attained a maximum ground amplitude at Kew of 89 μ at 21h. 56m. 57s. U.T., the recording being complete at 23h. 55m. U.T. The epicentre may have been 8,700 km. from Kew, almost in a south-westerly direction. On October 30 an earthquake shock of considerable strength was reported from Switzerland. No further details are so far available.

Reginald Farrer (1880–1920).

THE pre-war vogue of rock gardens owes much to the enthusiasm of Reginald Farrer (1880–1920). His home was in Ingleton, Yorkshire, where the natural scenery is itself a rock garden, and Farrer began to combine this beauty with horticultural concentration of colour at the early age of fourteen. Two short papers by E. H. M. Cox, one of Farrer's collaborators, and Humphrey Denham (*J. Roy. Hort. Soc.*, **67**, Pt. 9; 1942) portray Farrer's life and his contributions to gardening. Having exhausted the possibilities of the European Alps, he made two expeditions to China; from that country he introduced the beautiful threepenny-bit rose (*R. Farreri*), *Buddleia alternifolia*, several species of Rhododendron, *Aster Farreri*, *Viburnum fragrans*, and many others. Aside from his botanical contributions, Farrer's life is an outstanding study in determination; he had very poor physique and was "a Yorkshireman with an inferiority complex", yet his contributions to horticulture rank among the greatest.

John Amos Comenius

ON October 24, 1941, the tercentary of the visit of John Amos Comenius to England was commemorated at Cambridge, and in NATURE of November 22 there appeared an account of Comenius, his life and work, by Dr. Gerald Druce. It was then intended that the papers read at the commemoration would be published in permanent form. This intention has been carried out by the appearance of a volume entitled "The Teacher of Nations", containing all the papers read, whether short or long (Cambridge University Press, 5*s*. net). The volume, which is edited by Dr. Joseph Needham, contains also a chronological table showing the events in the life of Comenius, by Dr. R. F. Young, and a select bibliography of the works of Comenius by Anne Heyberger.

British Rheologists' Club

AT the annual general meeting of the British Rheologists' Club, held on November 6, the following officers were elected: *President*, Dr. C. F. Goodeve; *Honorary Secretary*, Dr. G. W. Scott Blair; *Honorary Treasurer*, Dr. V. G. W. Harrison. After the formal business, Prof. E. H. Rideal gave an informal address on "Solutions of Macro-molecules". Later, simple demonstrations were given by some members of the Committee to illustrate the Club's "Table of Deformations" (NATURE, **149**, 702; June 20, 1942).

Colonial Service Appointments

THE following appointments and promotions in the Colonial Service have recently been made: E. G. Cripps, agricultural officer, Nyasaland; G. R. Fenton, assistant conservator of forests, Sierra Leone; J. F. Hughes, assistant conservator of forests, Tanganyika Territory; C. C. B. Brown, veterinary officer, Tanganyika Territory; L. C. Stones, veterinary officer, Gold Coast; J. N. R. Brown (agricultural officer), senior agricultural officer, Tanganyika Territory.

Work of Scientific Men of the United Nations

THE Association of Scientific Workers is holding a conference on "Scientists of the United Nations and the War Effort" at Gas Industry House, 1 Grosvenor Place, S.W.1, on December 5 (2.30 p.m. and 6 (11 a.m.), under the chairmanship of Sir Richard Gregory, president of the British Association. Prominent scientific workers from more than fifteen countries will give addresses on the destruction and distortion of science in the oppressed countries and will show by contrast the contribution of scientific men of the United Nations who are in Great Britain to the war effort. Applications for invitations should be sent to the secretary, Foreign Scientists' Committee, Association of Scientific Workers, Hanover House, 73 High Holborn, W.C.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Effect of an Enzyme from Kidney on the Solubility of Calcium Phosphate

THE precipitation of sparingly soluble salts in organs like kidney and liver can no doubt be due to a variety of reasons. In the following note an experiment is described which may possibly show the mechanism of one of them.

It has been demonstrated lately that the solubility of calcium salts is increased by amino-acids[1]. A man who keeps his calcium intake constant but eats more protein absorbs more calcium and consequently excretes more of it through his kidneys[2]. This makes it likely that a proportion of the calcium inside the body is in the form of composition compounds between amino-acids and calcium salts.

Most calcium precipitates are found in kidney and liver. These organs are also richest in enzymes destroying amino-acids[3], a process which should lower the solubility of calcium salts.

Whereas pig's kidney destroys both *l* and *d* amino-acids, the *l* amino-acid oxidase is insoluble in water and an aqueous extract will only attack the *d* compounds[3]. This fact is used to devise an experiment, which demonstrates the transformation by *d* amino-acid oxidase of soluble calcium phosphate into insoluble precipitate.

Two solutions of 20 per cent alanine are prepared, one of the *d* (−) and one of the *l* (+) compound. To 1 ml. of each are added 1 ml. *N*/10 hydrochloric acid saturated with $CaHPO_4$. The addition of 1·3 ml. *N*/10 sodium hydroxide makes the solution slightly alkaline, but no calcium phosphate is precipitated due to the presence of the alanine. Acetone powder from pig's kidney (prepared according to Krebs[3]) is extracted by ten times its weight of water. 1 ml. of the filtered extract is added to each sample; a capillary is immersed from which a constant stream of oxygen is supplied. Both solutions are left for one hour at 30° C. Only the one which contained the *d* (−) alanine shows a considerable cloudy precipitate. After centrifugation a positive nitroprusside reaction is given by the supernatant, a sign that alanine has been deaminated to pyruvic acid. The centrifugate is resuspended in dilute nitric acid and filtered. Addition of sodium acetate and sodium oxalate to the filtrate leads to precipitation of calcium oxalate.

Time factor. Whereas much of the deamination occurs in the first half-hour, most of the precipitation takes place in the second half-hour. The effect of amino-acids on the solubility of sparingly soluble salts takes time to show itself. If, for example, alanine is added to a suspension of freshly precipitated calcium phosphate, a considerable time will pass before all precipitate has disappeared. The same is true for the reverse process. This can be demonstrated in the following way. An experiment is carried out as described above, but both samples contain *d* (−) alanine. After half an hour one tube is boiled for one minute to inactivate the deaminase. It is quickly cooled down again and filtered. Almost as much calcium phosphate precipitate will appear in the filtrate within the next thirty minutes as in the untreated sample within one hour.

Another way to demonstrate the time lag between deamination and calcium phosphate precipitation is to filter a sample containing *d* (−) alanine after half an hour and to apply nitrogen instead of oxygen for the next thirty minutes. Although the amino-acid oxidase cannot act in nitrogen, precipitation of calcium phosphate will continue under these conditions. A control containing *l* (+) alanine will show no change in calcium phosphate solubility.

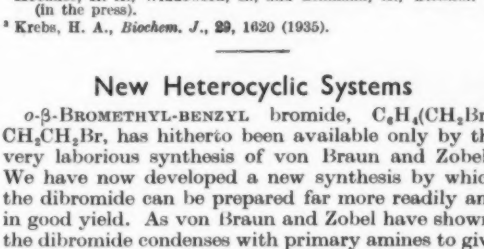
Some cloudiness can also be seen often in the samples with *l* (+) alanine. This is due to various reasons. One of them is denaturation of protein from kidney extract. The extract may also contain traces of iron which lead to a precipitation of ferric phosphate, the solubility of which is not influenced by alanine[1]. If after centrifugation the sediment is resuspended in acid and filtered, only traces of calcium can be discovered in the filtrate.

Biochemical Laboratory,
University of Cambridge.
H. LEHMANN.

[1] Lehmann, H., and Pollak, L., *Biochem. J.* (in the press).
[2] McCance, R. A., Widdowson, E., and Lehmann, H., *Biochem. J.* (in the press).
[3] Krebs, H. A., *Biochem. J.*, **29**, 1620 (1935).

New Heterocyclic Systems

o-β-BROMETHYL-BENZYL bromide, $C_6H_4(CH_2Br)$-CH_2CH_2Br, has hitherto been available only by the very laborious synthesis of von Braun and Zobel[1]. We have now developed a new synthesis by which the dibromide can be prepared far more readily and in good yield. As von Braun and Zobel have shown, the dibromide condenses with primary amines to give N-substituted-1 : 2 : 3 : 4-tetrahydro-*iso*-quinolines. In view of the occurrence of the *iso*-quinoline nucleus in many natural products possessing marked physiological activity, we are now condensing the dibromide with a wide variety of amines, in order that the chemotherapeutic properties of the resulting *iso*-quinoline derivatives may be investigated.



We find also, however, that the dibromide condenses readily with alkyl (or aryl)-dichloro-arsines in the presence of metals to give stable 2-alkyl (or aryl)-1 : 2 : 3 : 4-tetrahydro-*iso*-arsinolines (I): these compounds possess a new heterocyclic system isomeric with that in the 1 : 2 : 3 : 4-tetrahydro-arsinolines discovered by Burrows and Turner[2].

We have prepared a number of such tetrahydro-*iso*-arsinoline derivatives, and are investigating the preparation of similar derivatives containing phosphorus, antimony, tin, etc., in place of the arsenic. The chemotherapeutic activity of the compounds so obtained will be tested.

o-Xylylene-dibromide also condenses with aryl-dichloro-arsines to give 2-aryl-dihydro-*iso*-arsindoles (II), but the yield of these compounds appears to be markedly less than that of the corresponding members of series (I).

University Chemical Laboratory,
Cambridge.
Oct. 26.
F. G. MANN.
F. G. HOLLIMAN.
D. R. LYON.

[1] *Ber.*, **56**, 2142 (1923).
[2] *J. Chem. Soc.*, **119**, 430 (1921).

Superconductivity and Liquid Helium II

WHEN discussing our observations on the transfer of liquid helium II along solid surfaces above the liquid level[1], we pointed out that this mechanism of surface flow might also be responsible for the 'transport phenomena' in the bulk liquid (high heat conduction, low viscosity and the fountain effect)[2]. Subsequent experiments by ourselves[3], Allen and Reekie[4] and by Kapitza[5] strongly support this assumption. It appears that the transfer film observed above the liquid level also extends below it, covering all solid surfaces in contact with liquid helium II, and it is evidently in this film that the anomalous transport phenomena take place.

It has been suggested by F. London[6] that the λ-phenomenon in helium may be caused by the existence of helium atoms of very low (or zero) thermal energy, and the mechano-caloric effect found by us[3] strengthens this view. This effect shows that by flow along a solid surface, such thermally 'unexcited' atoms can be separated to a certain extent from the bulk liquid.

In elaborating our hypothesis we have now come across a striking analogy between the phenomenology of liquid helium II and superconductivity, which seems to go much farther than a superficial similarity. While we have a good deal of information on the superconductive state, our knowledge concerning liquid helium II is very limited. A certain amount of generalization has thus been necessary in the formulation of our thesis, which therefore must be considered as of an approximate nature only. The main points of the analogy are as follows:

(1) As it is impossible to establish a difference of electrical potential at the ends of a superconductor, so it is impossible to establish a temperature difference along the transfer film of helium II.

(2) In both cases the frictionless transport of particles (electrons or atoms) breaks down as soon as a certain value of flow is exceeded. This limiting value is given by the current threshold in superconductors, J, and by the rate of transfer, R, in helium[1].

(3) In both cases this limiting value of flow is solely dependent on temperature and is independent of the length of the path the particles have to travel. It is directly proportional to the width of the connecting surface (this holds rigidly for plane surfaces, whereas for curved surfaces the limiting rate of flow will be reduced in both cases).

(4) In liquid helium as well as in superconductors, the frictionless transport seems to be confined to the geometrical surface of the substance. Kapitza[5] has demonstrated that an anomalously high heat conduction does not take place in the bulk of helium II; that is, there is no frictionless transport of atoms unless this can take place along a solid – liquid boundary surface. An analogy to this exists in a superconductor, since it seems theoretically impossible to remove an electric charge from inside a completely closed superconducting shell except by the process of normal conduction.

(5) It appears that in both cases the maximum current density of flow on the surface (J, R) indicates the number of particles which can at each temperature be transported frictionlessly (provided one assumes the particles to have velocities independent of temperature). The threshold curve and the curve giving the temperature dependency of R will therefore play an identical part in the treatment of both phenomena. Indeed the shape of these curves is similar; they both start with a finite slope at the temperature at which the first anomalous behaviour is evident, and they both become temperature independent near absolute zero.

(6) When developing the thermodynamics of a superconductor with the current density rather than the magnetic field as the variable of state, one arrives at a formalism which also fits well the observations in liquid helium II. While the rigorous derivation of this cannot be given here, it appears that R^2 assumes the same significance in determining the free energy of liquid helium II as the square of the threshold field has for superconductors[7].

(7) One would expect that in such a model the specific heat of the system of superconductive electrons as well as that of the 'unexcited' helium atoms would be zero. This seems actually to be the case. The facts that a super-current in a temperature gradient produces no Thomson heat[8] and that no heat transport exists in a helium film in a direction opposite to that of the flow[1] strongly suggest that no heat is transferred to the particles while they remain in the anomalous state. We ascribe the observed high specific heat of superconductive metals and liquid helium II to the energy taken up in lifting particles from the lowest state into thermal equilibrium with the rest of the substance.

The question naturally arises what physical significance has to be given to this striking analogy. It seems to us that the fundamental phenomenon is the passing at finite temperatures of a number of particles into the lowest quantum state, where no energy exchange can take place between them and the remainder of the substance. This new form of aggregation of matter evidently follows quite general rules, so that the fact that the particles are electrons in one case and atoms in the other is only of secondary importance. The phenomenon of frictionless transport confined, as it is in both cases, to the geometrical surface, might be explained by the fact that, as the particles are free from interaction with the bulk of the substance, they can only be accelerated by external forces. The range to which these external forces can penetrate the substance limits the layer in which the transport takes place. Thus, in a superconductor, electrons can only be moved within the depth of penetration of an external magnetic field[9], while the flow in a helium film is limited by the extent of the van der Waals' forces of the container. It appears from these considerations that the theoretical interpretations of the superconductive state and of the λ-phenomenon in liquid helium II should be similar in their fundamental aspect, and it is with regard to such a generalized theoretical treatment that we hope the analogy pointed out in this note will be of value.

J. G. DAUNT.
K. MENDELSSOHN.

Clarendon Laboratory,
Oxford.
Nov. 5.

[1] Daunt and Mendelssohn, *Proc. Roy. Soc.*, A, **170**, 423 (1939).
[2] See, for example, Darrow, *Rev. Mod. Phys.*, **12**, 257 (1940), and Jones, "Reports on Progress in Physics", **6**, 280 (1940).
[3] Daunt and Mendelssohn, NATURE, **143**, 719 (1939).
[4] Allen and Reekie, NATURE, **144**, 475 (1939).
[5] Kapitza, *J. Phys. U.S.S.R.*, **4**, 181 (1941).
[6] London, F., *Phys. Rev.*, **54**, 947 (1938).
[7] Gorter and Casimir, *Physica*, **1**, 305 (1934).
[8] Daunt and Mendelssohn, NATURE, **141**, 116 (1938).
[9] London, H., *Proc. Roy. Soc.*, A, **152**, 650 (1935).

Tensile Strength of Water and Liquid Structure Theory

THE following note arises out of work in this Department examining erosive action from the point of view of liquid structure theory.

In a recent paper[1], R. Fürth suggests a theory of liquid structure in which holes in a continuum are treated by statistical mechanics. The picture of the theory is almost the reverse of the kinetic theory of gases, since holes move in a continuum instead of particles in a void. The holes are, however, supposed to contain vapour at the vapour pressure corresponding to the temperature.

Fürth's treatment indicates the existence of the known metastable state in which the temperature exceeds the saturation value corresponding to the pressure, the vapour pressure exceeding the hydrostatic. For the limit of this metastable state he obtains the defining equation

$$p_0 - p^* = \frac{1{\cdot}3\sigma^{3/2}}{\sqrt{kT}} , \quad . \quad . \quad . \quad (F.27)$$

where p_0 is the vapour pressure corresponding to the temperature T, σ is the surface tension, p^* is the hydrostatic pressure and k is Boltzmann's constant.

Substituting the value of surface tension for water at the region of normal atmospheric temperature (10° C.), we obtain a pressure difference of 80,000 lb./sq. in. If p^* is considered to be atmospheric pressure, the excess of vapour pressure demands a high temperature before it can be realized, and in this case has little meaning since the pressure is above the critical. Actually, however, the right-hand side needs to be altered to allow for different T, including the variation of surface tension, and the two sides become equated for water at about 337° C., where p_0 is about 2,000 lb./sq. in.

In practice, this order of superheat has not been obtained, due to the presence of particles and dissolved gas. The highest value is of the order 180° C. recorded for water in the form of a globule suspended in oil at atmospheric pressure[2].

Equation $F.27$ may, however, be regarded from another point of view. It is generally taken that the hydrostatic pressure p^* is not less than zero and therefore that $p_0 - p^*$ cannot be greater than the vapour pressure at temperature T. But if p^* could be taken to be negative this conclusion would not follow. The above data indicate that $F.27$ would be satisfied were p^* of the order $-$ 80,000 lb./sq. in., since p_0 at 10° C. is then negligible.

This suggests that the liquid should theoretically carry a tensile stress up to the limit of p^*. From the above figures the theoretical limit suggested at usual temperatures would be of the order 80,000 lb./sq. in., that is, 35 tons/sq. in. Again, however, the disturbing influence of particles and dissolved gases in promoting evaporation will give an actual limit which may be much less. Using the ordinary equations for the equilibrium of a bubble of radius r, the tensile limit suggested will be between $2\sigma/r$ and $4\sigma/3r$. Even radii so small as 10^{-4} cm. would make this limit of order less than one atmosphere, and in ordinary circumstances evaporation nuclei much greater than this exist in water. Thus the tensile stress which can be maintained by water is negligible.

While nuclei may exist, evaporation will not occur unless a suitable temperature distribution is formed to allow the conduction of heat into the nucleus, and that at a limited rate governed by the distribution and by the surface area. Hence a tensile stress above the limit imposed by the nuclei may persist for a short time, and the value attained would seem to depend on the relative times for evaporation and for growth of the stress. The suggestion is, therefore, that the ultimate limit corresponding to p^* derived from Fürth's theory could be carried for an infinitesimal time and hence would be transmissible as a tensile wave of rectangular wave front. A very steep tensile wave front could be expected, therefore, to be transmissible through water. Some evidence on explosion waves in water suggests that a considerable tensile wave is transmitted. Poulter[3] cites experiments indicating "several hundred kilogrammes per square centimetre", but no precise data appear to have been published.

R. S. SILVER.

Research Dept.,
G. and J. Weir, Ltd.,
Glasgow, S.4.
Oct. 26.

[1] *Proc. Camb. Phil. Soc.*, **37**, 252 (1941).
[2] Ewing, "Thermodynamics for Engineers", second edition (Cambridge University Press, 1936), p. 347.
[3] *J. Appl. Mech.*, **9**, A33 (1942).

Iron Electrode Potential in a Magnetic Field

REFERENCE is made in text-books on magnetism to experiments by Paillot[1] and others in which potential differences such as 0·05 volt for 30,000 gauss were obtained between an iron electrode in the field and another which is not. It seems, however, that one should expect only the much smaller potential difference calculable by equating the magnetic energy change involved per c.c. (7·8 gm.) of iron (which is $(\mu - 1)H_2/8\pi$) with the corresponding electrochemical energy (which is $V \times 10^9 \times 7{\cdot}8 \times 10^{-1}/0{\cdot}000289$), whence we get $V = (\mu - 1)H_2 \times 1{\cdot}5 \times 10^{-13}$ volts, the values for various fields being:

$H =$	100	1,000	10,000	30,000 gauss
$\mu - 1 =$	180	21	*c.* 2·0	*c.* 0·5
$V =$	0·26	3·1	*c.* 29	*c.* 67 microvolts

In testing the matter it was decided to use a permanent magnet, in spite of its lower field, so as to eliminate the possibility of stray potential differences from magnet coils. Preliminary trials with iron wire electrodes in a narrow cell, which could be slid between the pole-pieces of the magnet (*c.* 0·5 cm. apart) so as to put the two electrodes in the field alternately, gave potential differences of the magnitude found by Paillot, but rather irregularly and so slowly built up as to suggest that they were due to subsidiary causes such as reaction between ferrous salt and oxygen. This was proved to be the case by using a ferrous solution ($M/2$ $FeSO_4$) set by gelatine with a paraffin seal excluding air. Then a potential difference of about 2·7 μV. was regularly given as the field was switched from one electrode to the other. A first series of twelve rough observations gave the (single-direction) potential difference as 1·24 (± perhaps 0·2) μV., which corresponds to a field of 430 (± 70) gauss; a second series of twenty-one better observations gave the value 1·35 (prob. error ± 0·07) μV., corresponding to a field of 480 (± 24) gauss: these values agree well with the

fore play an identical part in the treatment of both

[9] London, H., *Proc. Roy. Soc.*, A, **152**, 650 (1935).

result of determinations with a modified Quincke 'hydrostatic balance', which gave the field as 470 (± 40) gauss.

The small potential differences of this effect were observed by microscopic reading of the pointer of a moving coil galvanometer (with phosphor-bronze strip, not pivot, suspension), the resistance of the circuit reducing the correspondence of one division of the eyepiece to 5·5 μV.—specimen readings being:

+	0·45	0·80	0·75	0·70	0·60	0·80
−	0·50	0·65	0·65	0·20	0·35	0·70,

these being 'drift' usually.

It is evident, then, this magnetic effect affords no insight into the mechanism of magnetism.

A. L. PARSON.

Hill Croft,
Allonby, Maryport,
Cumberland.
Oct. 25.

[1] *Comptes rendus*, 1900 1.

Chlorosis in Tomatoes

IN the west of Scotland, chlorosis of the leaves of tomato plants has been widespread during the past season and has been investigated at the West of Scotland Agricultural College, Auchincruive, Ayr.

Abnormal leaves of affected plants showed a characteristic appearance; the vascular system with a strip of adjacent lamina and the leaf margins remained green while the interveinal areas became a bright yellow colour (sometimes greenish-yellow).

In extreme cases the margins of the leaf also lost their chlorophyll, but the vascular system and adjacent lamina were not observed to lose chlorophyll under normal conditions of cultivation.

The chlorosis appeared first as small yellowish-green areas in the interveinal tissues and the leaves eventually became brittle and tended to die prematurely. The leaves immediately above the third truss were the most affected. Chlorotic plants produced less fruit on the upper trusses than did normal plants, and although unaltered in flavour, the fruit was smaller than usual. The composition of the lamina of normal and chlorotic leaves is given in the appended table and it is clear that the amount of magnesium in the chlorotic lamina is less than that in the normal.

With regard to the factors causing the chlorosis it was observed that only plants bearing a large amount of fruit on the first few trusses were chlorotic, although all such heavy bearing plants were not affected. It was seen also that the chlorosis usually appeared when the fruit of the first three trusses was almost fully developed, that is about the first week of June, and at that time the plants were still growing vigorously. The leaves produced by the plants in the latter part of the season, when yields were fairly small and active growth much diminished, were not chlorotic. It would seem, therefore, that the chlorosis is the result of extensive physiological drain to a large maturing crop of fruit and to actively developing leaves.

In our opinion the chlorosis is due to a deficiency of magnesium, although it should be borne in mind that the relatively small amount of magnesium in the lamina of abnormal leaves may be the result, and not the cause, of the chlorosis. That the chlorosis is a result of magnesium-deficiency is supported by the similarity between the chlorotic plants and plants which were grown in magnesium-deficient sand cultures, and by the comparable symptoms of naturally occurring magnesium-deficiency diseases of tobacco, potato and other plants. The amounts of replaceable magnesium were estimated in soils in which chlorotic plants were growing and the values obtained were high. The chlorosis, therefore, does not appear to be due to a deficiency of magnesium in the soil but rather to the plants being unable to absorb sufficient when the physiological demand is great.

Poor root action also appeared to play a part in the production of the chlorosis. This was indicated by the chlorosis often being associated with the presence of root rot fungi, poor physical condition of the soil and low soil temperature, all of which would reduce the ability of the plants to absorb magnesium.

Attempts were made to control the chlorosis by injecting solutions of magnesium salts but results were not satisfactory, although the injections did improve the condition of the chlorotic leaves to a slight extent. Further, chlorotic and normal leaves were rooted in sand and watered with culture solutions containing various ratios of potassium and magnesium, and with solutions free from these elements. These leaves remained in sand culture for three months and observations made during this period indicated that the chlorotic condition was associated with low magnesium and apparently also with a high potassium – magnesium ratio. The view that the absorption of magnesium is closely connected with the potassium – magnesium ratio in a culture or soil solution receives support from several sources. D. D. Brown[1] in his work on wheat showed that high concentrations of potassium in sand cultures reduced the amount of magnesium absorbed by the plants. Also, many workers have shown that when the concentration of potassium in soils and culture solutions is low, plants tend to accumulate magnesium. Further, the soils in the west of Scotland in which the chlorosis appeared

COMPOSITION OF THE LAMINA OF NORMAL AND CHLOROTIC LEAVES.

	Dry matter %	Ash % in dry matter	Ash % in original	Nitrogen % in dry matter	Nitrogen % in original	P_2O_5 % in dry matter	P_2O_5 % in original
Normal lamina	13·25	27·32	3·62	0·046	0·0061	1·38	0·18
Chlorotic lamina	13·05	22·75	2·97	0·036	0·0048	0·82	0·11

	K_2O % in dry matter	K_2O % in original	CaO % in dry matter	CaO % in original	MgO % in dry matter	MgO % in original	
Normal lamina	5·45	0·72	9·07	1·20	0·43	0·056	
Chlorotic lamina	6·34	0·83	6·21	0·81	0·10	0·013	

showed a very high concentration of potassium (0·1–0·3 per cent K_2O often being present), and soils containing less potash tended to produce healthy plants, always provided that the other growth factors were satisfactory.

It is interesting to note that the chlorosis appeared on soils having widely divergent *p*H values and that it was not influenced by liming.

The conclusion reached is that the chlorosis is due to a temporary deficiency of magnesium in the leaves resulting from physiological drain of the available magnesium from mature leaves to fruit and immature leaves. Poor root action and lack of balance between potassium and magnesium ions in the soil appear to be contributory causes. B. T. CROMWELL.

Department of Horticulture,
J. G. HUNTER.
Department of Chemistry,
West of Scotland Agricultural College,
Blythswood Square,
Glasgow, C.2. Oct. 30.

[1] *Soil Sci.*, **28**, 441 (1928).

Determination of Moisture Content

THE recent communication[1] on this subject prompts me to describe more fully a method for moisture determinations that was mentioned in an earlier letter[2].

The method as applied to a variety of substances used in confectionery manufacture consists of "mixing a suitable quantity (usually 5 grams) of material (warmed in the case of syrups, to reduce the viscosity) with an approximately equal weight of absolute alcohol, followed by five hours drying at 105° C. in a well ventilated oven." At this temperature decomposition, as shown by darkening, is slight even with acid sugar-containing substances. Slight increases in temperature above 105° C. greatly increase the amount of decomposition. The method gives reproducible results, and while after five hours absolute constancy of weight is not attained, losses after this period are very slight. The method is clearly not applicable to living plants or animals, as the nature of the material often prevents rapid and intimate mixing with the alcohol. For powdered material it appears an admirable method, especially for routine work when some fairly rapid, but not time-consuming, method is needed.

This method of moisture determination was introduced to me by Mr. H. R. Jensen.

Botanical Department, L. G. G. WARNE.
The University,
Manchester, 13. Nov. 5.

[1] Hallsworth, E. G., and Reid, R. L., NATURE, **150**, 524 (1942).
[2] Warne, L. G. G., NATURE, **148**, 594 (1941).

The Saqqara Graph

SINCE my communication published in NATURE of October 17, p. 460, an excellent example of an ancient Egyptian arch has come to hand in Plate 17 of Glanville's "Legacy of Egypt"[1], a photographic print of an imitation of matting in faience and stone on a panel from a gallery in the Step Pyramid at Saqqara. On testing the upper arc of this arch, I find that it is undoubtedly developed from a 5-unit circle in the way I suggested for the arch of the Saqqara graph.

Taking the height of the arc in the plate as 22½ mm. ($= aX = 2$ units), the base, YXY, of the parent circular arc is 91 mm., and the radius 56¼ mm. Erect twelve ordinates, 7 mm. apart, on YY, and then ordinates of the same height, but 8 mm. apart, on a base of 104 mm. The resulting segment is practically identical with that of the plate, the ordinates coinciding with the pillars of the arch.

This illustration of the use of the 3–4–5 right-angled triangle as a basis of arch construction is convincing, since the arch provides the evidential measurements. It comes from the same place, Saqqara, as the graph, and is of the same period, being variously ascribed to the IIIrd or IVth Dynasty.

Graywalls, R. S. WILLIAMSON.
Okehampton,
Devon.

[1] "The Legacy of Egypt", edited by S. R. K. Glanville. (Clarendon Press, Oxford.) Plate 17 comes in Chap. 5, written by R. Engelbach.

Role of Protozoa in the Activated Sludge Process

VARIATIONS in the biological activity of activated sludges have been ascribed to a number of causes, and attempts have been made to relate the presence of characteristic organisms to the activity of the sludge. Reynoldson[1] found that under the conditions existing at the Huddersfield Sewage Works, the logarithm of the Vorticella count in the activated sludge closely followed its biological activity, as measured by the purity of the effluents produced.

Pillai and Subrahmanyan[2] claim that the ciliate Epistylis is not only of paramount importance in influencing the actual oxidative processes performed by activated sludge, but also that it surpasses all other organisms in its ability to cause flocculation. It is worth noting that flocculation may be responsible for 40 per cent of the total purification effected by the sludge[3].

Examination of various types of activated sludge, produced under different conditions, lead me to conclude that the scanty knowledge available of the nutrition and development of Protozoa in activated sludge does not justify sweeping generalizations relating the protozoan count to biological activity. One activated sludge which has produced effluents of uniform composition over a period of many months sometimes contains relatively few classes of Protozoa, with a species of Epistylis preponderating, whereas at other times the protozoan fauna has been completely dominated by Paramecium, in numbers so great as to form 5 per cent or more of the bulk of the sludge. However, flocculation and oxidation proceed satisfactorily in the absence of Protozoa. It is still possible that the Protozoa play an important part in maintaining bacterial activity at a high level, but this has yet to be proved to occur in activated sludge.

The point I wish to make is that there is ample scope for a systematic study of the protozoan fauna of activated sludge, and its influence on the activity of the sludge. S. H. JENKINS.

Birmingham Tame and Rea District
Drainage Board,
Rookery Park,
Birmingham, 24. Nov. 14.

[1] Reynoldson, T. B., NATURE, **149**, 608 (1942).
[2] Pillai, S. C., and Subrahmanyan, V., NATURE, **150**, 525 (1942).
[3] Jenkins, S. H., and Roberts, S. J., *J. Soc. Chem. Ind.*, **58**, 225 (1939).

RESEARCH ITEMS

Heterogeneity in Wheat Germ and High B_1 White Flour

IN a paper "The Vitamin B_1 and Riboflavin Contents of Wheat Germ" just published (*Chem and Ind.*, September 1942), J. J. C. Hinton has shown that the two fractions of wheat germ, scutellum and embryo, differ in physical properties. More important is the fact that their B_1 contents are very different, that of the scutellum averaging 40 I.U. per gram and of the embryo 4 I.U. per gram. The riboflavin values, on the other hand, are roughly constant at 15 γ per gm. This work is of fundamental importance in flour milling, and T. Moran in an article published in *Milling* (October 10, 1942), has shown its application to Canada-approved white flour and high B_1 white flours generally. Nutritionally the ideal white flour would appear to be one containing the full amount, roughly 1½ per cent, of scutellum; the precise milling procedure necessary to obtain such a flour is a pretty problem in milling engineering. In dry milling, such as is now general practice in the milling of National flour, the scutellum adheres tenaciously to the adjoining endosperm and, therefore, probably finds its way into the finished meal. This is the explanation of the relatively high B_1, averaging 1·10 I.U. per gram, value of National flour.

Integument of Insects and the Entry of Contact Poisons

V. B. WIGGLESWORTH has recently published the results of some interesting work on this subject (*Bull. Entom. Res.*, **33**, 205–218; 1942). He deals in particular with certain structural and physiological features of insect cuticle and their relation to the entry of contact insecticides—in special extracts of pyrethrum in oil. It is found that, as a rule, insects immersed in oils exude minute droplets of water over the surface of the cuticle. Factors governing the rate of entry of pyrethrum through the cuticle have been studied by the application of this substance in oil to a restricted area of the abdomen of the bug Rhodnius. Entry is more rapid in light than in heavy petroleum oils, but is very slow in vegetable oils. There are great individual variations, due chiefly to the thickness of the endocuticle and other factors. There is also evidence that the pore canals are important in connexion with the passage of pyrethrum through the endocuticle. Histological examination of the integument shows that, in the nymphs of Rhodnius, oils are first taken up by the epidermal cells around bristles and later by the general epidermis. The uptake of oil is much increased by adding 5 per cent of oleic acid to refined petroleum. Among adult Rhodnius, soon after ecdysis, oils are taken up by the general epidermis, whereas in old insects they are taken up only by the dermal glands.

Parthenocarpy Induced by Frost in Pears

THE occurrence of frost when fruit trees are in bloom is generally regarded as detrimental if not disastrous. However, D. Lewis (*J. Pom. and Hort. Sci.*, **20**, 40; 1942) has shown that in some cases it may be instrumental in producing a crop. Among pear varieties, Conference and Fertility are usually regarded by growers as self-fertile, but indoor tests at the John Innes Horticultural Institution have shown them to be highly self-sterile. Outdoor tests under isolated conditions, on the other hand, resulted in the production of fruits by both varieties after self-pollination. The Fertility fruits were seedless whereas those of Conference dropped before full maturity. It was noticed that the styles of many of the flowers of the outdoor trees were blackened by frost at the time of pollination and it seemed likely that parthenocarpic fruits had been developed by the action of cold. This hypothesis was tested by keeping individual branches of potted trees at low temperatures from 0° C. to −9° C. for varying periods. Out of nineteen flowers kept at −9° C. for 18 hours, nine swollen fruits were produced, of which two reached maturity. These were good, well-shaped specimens, but contained no seeds and only traces of ovules. At other temperatures many fruits were produced but dropped in June before reaching maturity. It is concluded that cold stimulation may play a great part in maintaining regular bearing in some pear varieties. In a cold spring in which insects are not active to effect cross-pollination, a frost at the time of flowering, instead of doing damage, may be the making of a good crop.

Volatile Products from Apples

ETHYL alcohol, acetylene and ethylene are among the volatile substances known to be evolved from ripening apples. The latter is of considerable commercial importance because of its ability to initiate ripening in green fruits and cause injury to the skin of ripe apples. Other substances as yet unidentified are presumed responsible for the appearance of 'scald'. L. P. Walls (*J. Pom. and Hort. Sci.*, **20**, 59; 1942) has improved on the current methods of estimating these volatile products by using sulphuric acid, activated by the addition of 2 gm. silver sulphate per 100 ml. as an absorbing agent. Preliminary tests with a stream of air containing ethylene (1 in 10,000) showed that more than 90 per cent of the ethylene was absorbed. The condensable and odorous products from King Edward VII and Laxton's Superb apples were absorbed in a preliminary trap of ordinary sulphuric acid, which accounted for about one third of the total volatile products. Most of the remaining two thirds was absorbed in a second trap containing activated acid. This acid reacted quantitatively with chromic acid giving acetic acid in amounts agreeing with the assumption that the bulk of the absorbed substance was ethylene. It is concluded, therefore, that ethylene forms a high proportion of the volatile substances produced during the storage life of the apple. By the use of adsorbents, the production of volatile substances more readily condensable than ethylene and of possible importance in relation to scald was confirmed. Among these the acetic and formic esters of amyl alcohol were identified.

Auxin and Leaf-Protein

A NUMBER of hypotheses have been advanced concerning the substances from which auxin is released in the plant. S. G. Wildman and S. A. Gordon (*Proc. Nat. Acad. Sci.*, **28**, 217; 1942) have shown that proteolytic enzymes release auxin from the proteins in the leaf of spinach. Proteins from both cytoplasm and from the chloroplasts release auxin after enzymatic hydrolysis by tryptic extract, trypsin and chymotrypsin. Papain produced little hydrolysis at *p*H 4 or 6. Diffusion experiments indicate that leaf auxins and the auxins released from the protein of the leaf are similar and of lower molecular weight than indol-acetic acid.

Systematics of Polychæta

OLGA HARTMAN has examined critically fifty type specimens of Polychæta in the United States National Museum ("The Identity of some Marine Annelid Worms in the United States National Museum", *Proc. United States Nat. Mus.*, **92**; 1942). The species have been minutely examined, and emended descriptions are given in most cases. Among these type specimens is *Phyllodoce fragilis* Webster, and it is interesting to learn that the author has collected this species frequently at Beaufort, N.C., where it has a tendency to mass together in the interstices of oyster clumps. One new species is proposed, *Lumbriconereis moorei*, for two fragmentary specimens allied to, but not identical with, *L. minuscula* Moore. These occurred in 1,350–2,182 fathoms off Catalina Island and possess greatly elongated setæ in the anterior segments—a characteristic apparently of certain deep-water forms, or, possibly, of a unique type of substratum. Most of those with this particular feature occur on blue mud. E. and C. Berkeley publish a list of Polychæta collected at the northern extremity of the west coast of North America ("North Pacific Polychæta, chiefly from the West Coast of Vancouver Island, Alaska and Bering Sea", *Canad. J. Res.*, **20**, No. 7; July 1942). There are interesting remarks connected with some of the species. Observations on *Phyllochætopterus prolifica* Potts confirm Potts's own supposition that although he observed no individuals with sexual products (having described in some detail the process of asexual reproduction) this was probably due to insufficient examination. The present work shows that mature individuals of both sexes have frequently been found in tubes. There are four new species in this collection, including two of Pista, *P. pacifica* and *P. moorei*.

Mycological Taxonomy

A STUDY of type species of agaricaceous genera by Rolf Singer (*Lloydia*, **5**, No. 2; June 1942) utilizes modern conceptions of the presence of clamp connexions in hyphæ, and the presence of starch or other substances in spores, as practical diagnostic characters even in old, dried herbarium specimens. Most of the types studied are peculiarly American, but the British mycologist can obtain useful ideas on taxonomy in general, for several keys to small groups of genera are given, upon the above criteria. Fifty-two new species of fungi from Florida are described in the same number of *Lloydia* by Wm. A. Murrill. These are named according to American groups, but are mainly included under Saccardo's genera Psathyra, Panæolus, Galera, Tricholoma, Clitopilus, Volvaria, Hygrophorus and Collybia.

Cultivation of Derris in India

THE main toxic constituent of derris is rotenone, but along with it are several other related toxic substances. These substances have, hitherto, been found to occur in only a few species of plants belonging to the natural order Leguminosæ. T. P. Ghose in a communication entitled "A note on *Derris* and other Rotenone Bearing Vegetable Insecticides, their Occurrence and Possibilities of Cultivation in India", has discussed this subject (*Indian Forest Leaflet*, No. 20 (Chemistry). Forest Research Institute, Dehra Dun, 1942). It appears that search for such rotenone-bearing insecticides has resulted in the discovery of rotenone in the following plants that are indigenous to India: *Derris ferruginea*, *Millettia pachycarpa* and *Tephrosia candida*. The existing material is sufficiently rich for the preparation of efficient fluid or powder insecticides. It is suggested that by selection of suitable strains and by proper cultivation it may be possible to improve the rotenone content of the above mentioned species. Furthermore, several localities in India have suitable climatic and soil conditions to warrant the introduction and cultivation of richer varieties of commercial derris such as *Derris elliptica* or *D. malaccensis* indigenous to Malaya. Experiments have been carried out that yielded encouraging results in Mysore, Cochin and Assam.

Copper-bearing Protein in Cow's Milk

THE presence of copper in tissues is known to be essential for the formation of hæmic iron in animals and to play a part in the form of copper proteins as oxidases in plants. The presence in animal tissues of a non-hæmin iron associated with copper as a copper-iron nucleoprotein is reported. Cow's milk contains 0·09–0·17 mgm. of copper per lit., and W. L. Dills and J. M. Nelson (*J. Amer. Chem. Soc.*, **64**, 1616; 1942) isolated from it a protein containing about 15 per cent of nitrogen and 0·19 per cent of copper. Dialysis showed that the copper was non-ionic. Enzymatic activity was not found either in relation to ascorbic acid oxidase activity or polyphenolase activity.

Ester Hydrolysis

THE reactions between tertiary butyl and benzyl nitrates with water and hydroxyl ion differ; in the first case, hydrolyses to alcohol and to olefin occur:

$$C_4H_9ONO_2 + 2H_2O = C_4H_9OH + H_3O^{\cdot} + NO_3' \quad (A)$$
$$C_4H_9ONO_2 + H_2O = C_4H_8 + H_3O^{\cdot} + NO_3', \quad (B)$$

whilst in the second no olefin is produced but the alcohol-forming reaction is accompanied by a first order reaction giving benzaldehyde and nitrous acid:

$$C_6H_5CH_2ONO_2 + 2H_2O = C_6H_5CH_2OH + H_3O^{\cdot} + NO_3' \quad (C)$$
$$C_6H_5CH_2ONO_2 = C_6H_5CHO + HNO_2; \quad (D)$$

and second order reactions with hydroxyl ion:

$$C_6H_5CH_2ONO_2 + OH' = C_6H_5CH_2OH + NO_3' \quad (E)$$
$$C_6H_5CH_2ONO_2 + OH' = C_6H_5CHO + H_2O + NO_2' \quad (F)$$

G. R. Lucas and L. P. Hammett (*J. Amer. Chem. Soc.*, **64**, 1928; 1942) show that the kinetics of the reactions strongly indicate identical mechanisms for the *t*-butyl nitrate and halides, the latter previously investigated by Ingold and collaborators (*J. Chem. Soc.*, 925, 960 f.; 1940). No appreciable reaction with hydroxyl ion or catalysis by acids was observed. It is shown that perchlorate ion accelerates the reaction but hydroxyl ion retards it, and other ions have intermediate effects which parallel their effects on the activity of water in the medium. This materially weakens a kinetic argument previously used for a free carbonium ion intermediate in hydrolytic reactions. The kinetics of hydrolysis of benzyl nitrate to benzyl alcohol suggests that the reaction partakes more largely of true hydrolysis rather than displacement of anion by a water molecule than does that of the halide. There is pronounced acceleration by hydroxyl ion but acids have no effect. These results suggest that the explanation of the mechanism of ester hydrolysis is less final than has recently been supposed.

INSECT FAUNA OF A BRINE-PIT

By FREDERICK BURKE

THE brine-pit[1] described is apparently a disused well from which brine was formerly pumped (Fig. 1). It is situated on the south side of Wychbrook, the boundary between Cheshire and Flintshire (detached), and about two miles south of Malpas. The pit is roughly circular in shape with an approximate diameter of 25 ft. According to Ormerod[2], it was sunk through clay to the depth of 450 ft., or 300 ft. below sea-level. In May 1941, during a preliminary visit, numerous dipterous larvæ and pupæ were discovered in the pit water. Analysis of the water, at that time, showed a salinity of 9,400 parts per 100,000. So far as can be ascertained, little attention appears to have been directed, in Great Britain, to the insects inhabiting pools of high salinity such as are to be found in parts of Cheshire. Pending a more detailed account, therefore, the following notes have been compiled from observations made over a period May 1941—August 1942 inclusive. During this period the pit has been visited on nine occasions.

TABLE 1.

Date of sampling	*p*H value (Lovibond comparator)	Sodium chloride Parts per 100,000	Total salts Parts per 100,000
18.5.41	7·2	9,400	— †
15.6.41	6·4	9,500	10,200
20.7.41	7·8	9,100	— †
31.8.41	8·7	9,100	— †
12.10.41	8·0	7,900*	8,500
14.12.41	8·0	8,000*	8,800
2.5.42	6·5	9,400	10,300
21.6.42	7·5	9,500	10,400
16.8.42	8·5	9,400	10,300

* Samples collected after a period of very wet weather.
† Undetermined.

TABLE 2.

Depth	*p*H value (Lovibond comparator)	Sodium chloride Parts per 100,000	Total salts Parts per 100,000
Surface	8·5	9,400	10,300
10 ft.	7·0	9,300	10,200
20 ft.	6·5	9,300	10,200
30 ft.	6·5	9,300	10,200

Analytical values for surface samples of water collected at each visit are given in Table 1. Values for samples collected with a Meyer's bottle[3] from 10, 20 and 30 ft. below the surface of the pit are given in Table 2. These tables present a general picture of the environmental conditions existing at the pit. It will be seen that throughout the period indicated the water has maintained a fairly constant salinity, although slight variations occur depending on the rainfall and on the amount of evaporation which takes place.

Fig. 1. THE BRINE-PIT, MALPAS.

Fig. 2. LARVA OF *Ephydra riparia*, SHOWING RETRACTABLE SPIRACLES AND HOOKED SEGMENT. × 12.

The following insects have been identified from the pit:

Ephydra riparia Fallén (Diptera) is the predominating insect breeding in the pit and it occurs in very large numbers. The larva is remarkable for its interesting forked tail which carries two retractable spiracles (see accompanying photograph). In addition, it possesses a curious hooked segment, on the back near the end of the abdomen, with which it attaches itself to pieces of twig and similar objects at the time of pupation. *Ephydra riparia* belongs to the family Ephydridæ, a group of insects which appears to be particularly well adapted to life in a variety of unusual habitats. Carpenter[4] states that all species of Ephydra are capable of living in high concentrations of salt. Several species have been recorded by Thorpe[5] from brackish pools on the Sussex coast. It is interesting to note also that the petroleum pools of California are inhabited by the larva of a fly described by Thorpe[6] as a member of this family.

The specimens of *Ephydra riparia* which have been collected from Malpas brine-pit were highly parasitized by a small chalcid (Hymenoptera) belonging to the family Pteromalidæ. Many of the species of this group are at present undetermined and in consequence this parasite unfortunately remains unidentified.

Nemotelus notatus Zett. (Stratiomyiidæ) is another dipteron recorded breeding in fairly large numbers in the shallow water around the pit edge. The larva, when not crawling over the mud, has a curious habit of remaining submerged in shallow pools with a bubble of air attached to its posterior spiracles. Larvæ, pupæ and perfect insects of Nemotelus have been collected from time to time. Thorpe[5] records a species of Nemotelus from the Sussex coast.

Pupæ of the dipteron *Atissa pygmæa* Haliday were first observed at the pit on August 31, 1941. Only

one perfect insect, however, emerged on September 1, 1941, from those pupæ which were collected. *Atissa pygmæa* was seen on frequent occasions during later visits to the pit, but it was never found in any great numbers.

From the observations here recorded it is interesting to note that the insects found in such an unpromising environment are all members of the Diptera. In this connexion it is perhaps well to repeat the statement made by Thorpe[7] that "the Diptera are not only able to support life in media of an osmotic pressure that is rapidly fatal to most other insects, but that they have also a greater power of adaptation to changes in concentration than have other orders".

In concluding this brief account of the insects inhabiting the brine-pit, mention should perhaps be made of those insects which from time to time have been discovered in the pit water but do not actually breed in the brine. On several occasions the hemipteron Corixa (species undetermined) was observed to visit the pit and swim for short periods in the water. On August 31, 1941, the beetle *Ilybius fuliginosus* F. was captured while swimming in the water. On June 21, 1942, an unidentified Hydrobius larva was taken when collecting water samples.

It is a pleasure to record here my acknowledgement of the assistance given by Mr. Riley, Mr. Coe and Mr. Donisthorpe of the British Museum, and of Mr. H. Britten of Manchester, in the identification of the insects found. I wish also to thank Mrs. Kay of Brine-pits Farm, Malpas, for permission granted to visit the pit; and finally to my wife for help in collecting.

[1] Sherlock, Mem. Geol. Survey, Mineral Resources of Great Britain, Rocksalt and Brine, **18**, 54 (1921).
[2] Ormerod, G. W., *Quart. J. Geol. Soc.*, **4**, 269 (1848).
[3] Ward, H. B., and Whipple, G. C., "Fresh-water Biology", 80 (1918).
[4] Carpenter, K. E., "Life in Inland Waters", 228 (1928).
[5] Thorpe, W. H., *Trans. S.E. Union Sci. Soc.*, 27–34 (1927).
[6] Thorpe, W. H., *Trans. Entom. Soc. Lond.*, **78**, 331 (1930).
[7] Thorpe, W. H., *The Pan-Pacific Entomologist*, **7**, 145 (1931).

WAR-TIME TRANSPORT IN GREAT BRITAIN

THE Fifteenth Report of the Select Committee on National Expenditure demonstrates the vital importance of transport to the war effort of Great Britain. That bad transport is one of the main causes of absenteeism and lost time in production has been emphasized from time to time in the Select Committee's earlier reports, and the evidence received during the last six months led the Committee to make a special investigation into this problem from the side of the Ministry of War Transport and the transport undertakings. While this aspect of the problem is fairly generally appreciated, it is intimately if not inseparably linked with that of passenger transport generally, and the full extent of the repercussions of the rubber and petrol situation are very far from being realized by the general public.

The evidence submitted to the Select Committee indicates that there are few, if any, services running which are not essential. The recent restrictions on the use of motor-cars in Great Britain render buses more than ever necessary for meeting the needs of the general public. Even in non-industrial areas, there is already a shortage, and there, as elsewhere, intending passengers are frequently left behind. The priority system is only partly effective in securing the transport of industrial workers. It is open to abuse, and the practical impossibility of distinguishing between essential and non-essential passengers is one of the first factors in the situation to which regard must be paid.

The second factor, which is by no means fully recognized, is the effect which transport restrictions have already had on industrial efficiency. There is a serious handicap, for example, on management, because it is no longer possible to choose the quickest and most efficient means of transport. Economy in petrol often means waste in man-hours. Moreover, not only is output affected in the factories if workers and management cannot arrive in time but also, as the Select Committee points out, the morale of the country will be affected if the housewife cannot do her shopping or if her child cannot get to and from school. It might well be added that workers in the larger towns, with their longer hours in a heavily polluted atmosphere, will suffer in health and their work in efficiency if transport restrictions deprive them entirely of access to fresh air and the countryside. No long-term policy of planning the war, such as we should now be pursuing, can safely disregard such considerations, and the severer the limitations of transport the more essential it becomes to plan their use to the maximum extent.

Transport, in fact, occupies a key place not only in the production of munitions, but also in the daily life of every man, woman and child in Great Britain. The vital importance of transport must be kept constantly in mind when questions of priority of labour and materials are decided. Indeed, the Select Committee is not merely concerned with the fair and efficient use of existing facilities; it also gives frank warning that it may well be essential to increase those facilities, and reference is made in particular to provision for the manufacture of buses and spare parts and for the supply of fuel and tyres.

What emerges from this survey is the importance of securing full co-operation between the transport services themselves and the general public which uses those services. One of the major difficulties is the labour shortage, which is aggravated by a high percentage of absenteeism among women workers, and the Ministry is criticized for its neglect to make any serious effort to ascertain the causes of such absenteeism.

Many of the Committee's suggestions are on points of practical detail. In regard to the difficult question of staggering hours in shops or factories, it recommends the establishment of local transport consultative committees in all areas and the introduction of schemes for internal or general staggering of factory hours. When such schemes are being worked out, the factories affected should be grouped roughly according to the priority of their products, so that some attempt may be made to allot the best time to the most important factories. Regional commissioners in all regions should make orders enforcing the early closing of shops in the central shopping sites of large cities, so that both shop-workers and customers can be got home before the rush of factory workers begins, and employers should, where necessary, make arrangements that their employees get reasonable shopping facilities during these restricted times. Similarly, it is recommended that except in emergency, factory hours should not be altered without first considering the transport problems

involved, and the local transport consultative committees should be fully used for such purposes.

If, however, the public themselves are to help to improve the transport services of Great Britain, much greater publicity must be given to the reasons for transport difficulties. "Transport goes to War", recently issued by the Ministry of Information, makes a beginning although the emphasis is rather excessively on the blitz conditions and effects: what is wanted is something to grip the public imagination and secure their support and sympathy under everyday war-time conditions. Moreover, any appeal for the co-operation of the public, such as the Select Committee suggests, must be based not merely on a fuller understanding of the difficulties of the transport services themselves, but also on a sympathetic appreciation of the position and difficulties of the travelling public. The importance of diverting more traffic from the roads to the railways is stressed, and it is recommended that where adequate railway facilities are available for any particular factory or group of factories, special bus facilities should not be provided. Similarly, the natural tendency for people to rush for the last bus which gets them to their work at the right time requires correction by individual response, but apart from an examination by the Ministry of Labour of the possibility of reducing cross-travelling between one town and another by directing workers to places nearer their homes, it may well be doubted whether there is much unnecessary travelling by train on the part of the general public, at least over distances of any extent. It is clear from this report that the point has been reached, if not passed, when a further reduction in travelling facilities, whether by bus or rail, is likely to be a false economy, and to impair the war effort to an extent more rather than less serious, because the waste of time, of labour or of health that results may be indirect and cumulative rather than immediately obvious.

FORTHCOMING EVENTS

(Meetings marked with an asterisk are open to the public)

Saturday, November 21

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (at 16 Princes Gate, South Kensington, London, S.W.7), at 2.30 p.m.—Symposium on "Industrial Radiography".

Monday, November 23

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. A. C. Pallot: "Some Aspects of Insulation", 1: "Thermal Insulation at Medium Temperatures—The Insulation of Pipes and Structures" (Cantor Lectures, 1).

BRITISH COUNCIL, ROYAL ASIATIC SOCIETY, EAST INDIA ASSOCIATION AND THE INDIA SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Mr. Laurence Binyon: Fourth Centenary of the Mughal Akbar.

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Kodachrome Film: "Halifax to Victoria B.C."; Commentary by Mr. C. W. Stokes.

Tuesday, November 24

CHADWICK PUBLIC LECTURE (in the Sir Edward Meyerstein Lecture Theatre, Westminster Hospital Medical School, 17 Horseferry Road, London, S.W.1), at 2.30 p.m.—Sir Arthur MacNalty, K.C.B.: "The Prevention of Tuberculosis in Peace and War".*

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 3 p.m.—Prof. J. C. Drummond: "The History of our More Important Foods", (i) Bread.*

INSTITUTION OF CIVIL ENGINEERS (ROAD ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Mr. A. H. D. Markwick and Mr. H. S. Keep: "The Construction of Bases for Roads and Aerodromes using Local Aggregates and Soils".

ASSOCIATION OF SCIENTIFIC WORKERS (at the Royal Photographic Society, 16 Princes Gate, South Kensington, London, S.W.7), at 6.30 p.m.—Projection of the Cine Films entered for the Exhibition of "Photography in Science and Industry".

Wednesday, November 25

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Royal Institution, Albemarle Street, London, W.1), at 3 p.m.—Mr. G. T. Winch: "Photo Cells and their Applications".

Friday, November 27

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Mr. Frank Twyman, F.R.S.: "Interferometry in the Optical Workshop".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. R. C. Thompson and Mr. Harry Hunter: "The British Merchant Shipbuilding Programme in North America, 1940-42" (Andrew Laing Lecture).

Saturday, November 28

ROYAL PHOTOGRAPHIC SOCIETY (at 16 Princes Gate, South Kensington, London, S.W.7), at 3 p.m.—Dr. S. O. Rawling: "Sensitometry since Hurter and Driffield" (Hurter and Driffield Memorial Lecture).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN ENGINEERING SUBJECTS—The Principal, Kingston Technical College, Kingston, Surrey (November 28).

VISITING MATHEMATICS LECTURER—The Principal, Froebel Educational Institute, Knebworth House, Knebworth, Herts (December 1).

LECTURER IN MECHANICAL ENGINEERING at the Rugby College of Technology and Arts—Mr. P. I. Kitchen, Organizer of Further Education, Rugby (December 2).

INSTRUCTOR IN BEEKEEPING—The Education Officer, County Hall, Wakefield (December 14).

REGIUS PROFESSOR OF GEOLOGY at Edinburgh University—The Private Secretary, Scottish Office, Fielden House, 10 Great College Street, London, S.W.1 (January 11).

ASSISTANT TECHNICIAN IN THE PATHOLOGICAL DEPARTMENT—The Superintendent, Grimsby and District General Hospital, Grimsby.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 13, No. 4, March, 1942. Compiled by Agnes Elizabeth Glennie, assisted by Catherine Alexander. Pp. iv+233-315. (London: H.M. Stationery Office.) 4*s.* 6*d.* net. [810

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